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# Visualization, mapping, and the history of mobility in the Middle Ages

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**ABSTRACT**

This paper reviews digital methods of scholarship for visualization and mapping, and it then shows how creative and experimental visualization can help us to study the extensive networks that lay behind human mobility, from trade to war, communication, pilgrimage, migration, and much else. In the process, the paper will familiarize historians with the key aspects of digital methods from amalgamating large quantities of data to finding patterns within that data. This discussion of visualization along with the sample maps should demonstrate that digital methods offer a new tool to enhance traditional scholarship and shape richer facts and arguments.

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## Introduction

Historians have long used maps and other visualizations in their research. Many of us first learned about the past by looking at atlases, which are full of information on states, empires, politics, and battles.[1] Nonetheless, the inclusion of tables, charts, or maps in our research has long been seen as ancillary to our main

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[1]Two examples of such books from the 1970s are *National Geographic Picture Atlas of Our Fifty States* (Washington, DC: National Geographic Society, 1978) and Hermann Kinder and Werner Hilgemann, *The Anchor Atlas of World History: Volume II From the French Revolution to the American Bicentennial*, trans. Ernest A. Menze with maps designed by Harald and Ruth Bukor (New York: Anchor Books, 1978); we discuss several recent digital examples later in the article.

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argument, which is generally built on a close reading of archival sources. These visualizations are important reference tools, but they are often created at the end of the analytical process to illustrate a point, not to make a point. Plus, in the case of maps, many of us turn to cartographers to create them. Yet, today, historians of all sorts have a great opportunity to enrich their arguments and their communication by incorporating visualizations into their work, and using them to carry an argument as much as illustrate conclusions.[2]

If in the late twentieth-century, few scholars had the programming skills or computational apparatus to generate good visualizations, contemporary computer technology has made primary source visualization accessible to all scholars with a standard computer. With a little effort, we can all make bar charts, pie charts, or line graphs in Excel. With a little more training, we can map historical data using different analytic software such as Geographical Information Systems (GIS) programs.[3] There is a real opportunity to naturalize visualization within our historical work and use digital technology to create new historical arguments. Moreover, "playing with technology" enhances our traditional research practices of close reading of texts and helps us to build knowledge in more interactive ways with our students.[4] It also allows us to probe our sources (organized in spreadsheets) quickly for patterns and connections. Digital methods provide a new toolbox to maintain scholarly rigor and construct more nuanced and richer historical arguments.[5]

One area in which digital methods have been particularly fruitful is in mapping.[6] Most of us are aware of the general geography of the regions we

[2]For a collection of annotated examples of making historical arguments with digital resources and datasets, see Lincoln Mullen and Stephen Robertson's curated website *Models of Argument-Driven Digital History: Arguing with Digital History, Patterns of Historical Interpretation* (https://model-articles.rrchnm.org/articles/introduction/) (accessed June 18, 2023).

[3]For an excellent survey of various ways to visualize "big data," see Shawn Graham, Ian Milligan, and Scott Weingart, *Exploring Big Historical Data: The Historian's Macroscrope* (London: Imperial College Press, 2016), especially chapter 5.

[4]Kevin Kee, "Introduction," in Kevin Kee, ed., *Pastplay: Teaching and Learning History with Technology* (Ann Arbor: The University of Michigan Press, 2014), 1–3, 14.

[5]For more on digital tools and methods in the humanities, see David M. Berry, ed., *Understanding Digital Humanities* (New York: Palgrave MacMillan, 2012); Anne Burdick, Johanna Drucker, Peter Lunenfeld, Todd Presner, and Jeffrey Schnapp, *Digital_Humanities* (Cambridge, MA: MIT Press, 2012). For medieval studies in particular, see Laura Morreale and Sean Gilsdorf, eds., *Digital Medieval Studies: Practice and Preservation* (Leeds: ArcHumanities Press, 2022); and Jennifer E. Boyle and Helen J. Burgess, eds., *The Routledge Handbook of Digital Medieval Literature* (London: Routledge, 2018).

[6]A few helpful volumes on spatial history/humanities to start exploring this field are David J. Bodenhamer, John Corrigan, and Trevor M. Harris, eds., *Deep Maps and Spatial Narratives* (Bloomington: Indiana University Press, 2015); Charles B. Travis, *Abstract Machine: Humanities GIS* (Redlands, CA: ESRI Press, 2015); Ian N. Gregory and Alistair Geddes, *Toward Spatial Humanities: Historical GIS & Spatial History* (Bloomington: Indiana University Press, 2014); David J. Bodenhamer, John Corrigan, and Trevor M. Harris, eds., *The Spatial Humanities: GIS and the Future of Humanities Scholarship* (Bloomington: Indiana University Press, 2010); Anne Kelly Knowles, ed., *Placing History: How Maps, Spatial Data, and GIS are Changing Historical Scholarship* (Redlands, CA: ESRI Press, 2008); and Ian N. Gregory and Paul S. Ell, *Historical GIS: Technologies, Methodologies and Scholarship* (Cambridge: Cambridge University Press, 2007).

study and the location of key towns; however, we often treat them as a sort of context, held in reserve. We put to the side references to smaller locations, streets, or neighborhoods that seem irrelevant to the larger narrative we are developing. The possibility of having a more consistent recognition of precise geography in time, however, can deepen our historical imagination. Because historians have usually taken geography to be secondary, our work has often left out ideas and methods more intensively studied by geographers.[7] As a result, our methods, even our note taking, often make it too easy for us to overlook patterns in the aggregation of small geographic mentions and we too often miss the chance to tell more nuanced stories, more historically apt stories. Bringing an understanding of spatial analyses and visualizations into our normal modes of inquiry can help to fill this gap.

The benefits of nuanced spatial analyses are significant and meaningful. Digital mapping, among other forms of digital visualization, is a means to analyze, interpret, and share historical information. Data visualizations are mediations of the process of turning evidence into data, and – when used thoughtfully – give us means to present the complexities of our sources that go beyond what can be done in traditional narrative or analytical prose. This is a significant methodological improvement for the field, a means to communicate both evidence and hypotheses while potentially adhering more closely to the complexities, inconclusiveness, and even messiness (or fuzziness) of the surviving evidence.[8] For instance, the modern boundary maps showing the extent of the Spanish American empire in historical atlases often obscure the uncertainty or inconsistency present in the original data. David J. Weber has noted that "independent Indians controlled over *half* of the landmass that we think of today as Spanish America."[9] Most maps of Spanish America clearly convey greater control than was truly the case. Earlier maps from the sixteenth century, however, often marked boundaries, especially between the Ottoman Empire and its European neighbors, more tentatively

[7]Geography has had a huge influence on environmental history and on many modern studies of human interaction with the landscape (even when such work veers toward geographical or environmental determinism – an argument initially used to defend European imperial expansion). The French Annales School, and especially Fernand Braudel, directly credited geography as a source for their expanded view of history, both in context and in its evidence base. See Alan R. H. Baker, *Geography and History: Bridging the Divide* (Cambridge: Cambridge University Press, 2003), 16–24; 72–75.

[8]J.B. Owens and Emery A. Coppola, Jr., "Fuzzy Set Theory (or Fuzzy Logic) to Represent the Messy Data of Complex Human (and other) Systems" (White Paper), https://www.academia.edu/1100044/Fuzzy_Set_Theory_or_Fuzzy_Logic_to_Represent_the_Messy_Data_of_Complex_Human_and_other_Systems (accessed June 18, 2023).

[9]See David J. Weber, "Bourbons and Bárbaros: Center and Periphery in the Reshaping of Spanish Indian Policy," in Christine Daniels and Michael V. Kennedy, eds., *Negotiated Empires: Centers and Peripheries in the Americas, 1500–1820* (New York: Routledge, 2002), 79. For a digital map comparing the lands of native peoples, the regions where specific native languages were spoken, and the territories defined by treaties in the service of conquest see: https://native-land.ca (accessed June 18, 2023).

with fortresses or military points.[10] The edge of a territory is not the legal boundary line, but the point where armies are most likely to engage in combat over territory.[11] Tracing the boundaries of a kingdom in the traditional way graphically implies a greater level of centralized control than was the case.[12] The iterative ability of computer mapping programs like GIS to generate multiple types of maps rapidly makes it easier to include changing boundaries, overlapping jurisdictions, and to explore spatial relations. That is, digital mapping tools permit us to visualize the same data in multiple ways in order to more accurately represent the complexities of past social dynamics and thereby fine-tune our narratives.

In this article, we discuss visualizations and mapping, along with their potential for historical work. In particular, we introduce aspects of visualizing medieval documentation to show how adaptations of traditional research methods can yield novel intellectual advances. In part 1, we offer a theoretical/methodological background on visualization. We touch on mapping and provide some caveats, as well as note how the new medium of "data" expands the variety of means we have at our disposal for telling stories. In part 2, we present several types of visualizations from simple point and line maps of road networks and infrastructure to more sophisticated, novel representations of movement – Ling Pillars. We hope that the overview and sample maps help to demystify the field of digital humanities for scholars new to visualization and mapping and thereby help them to see digital tools as "an extension of traditional knowledge skills and methods, not a replacement for them."[13] That way, more of us can play and learn together in the virtual sandbox.

## Part 1: visualization and mapping

Ever since scholars started creating new visualizations using computer algorithms, we have debated whether or not the technology itself clouds our critical view of the past. Certainly, Geographical Information Systems (GIS), like ArcGIS or QGIS, were not initially designed for historical research or the

[10]Palmira Brummett, *Mapping the Ottomans: Sovereignty, Territory, and Identity in the Early Modern Mediterranean* (Cambridge: Cambridge University Press, 2015), 127–28.

[11]As Mateusz Fafinski pointed out in a viral twitter thread concerning map-based depictions of the opening of the invasion of Ukraine, "every map is a projection of power … beware of maps bearing easy lines." https://twitter.com/Calthalas/status/1498998318755680260?s=20&t=FtnkRYGOf-sG-mcirSYntQ (accessed June 18, 2023). See, as well, Kyle J. Gardner, *The Frontier Complex. Geopolitics and the Making of the India-China Border, 1846–1962* (Cambridge: Cambridge University Press, 2021).

[12]For a more thorough discussion of borders, frontiers, and centers in the Middle Ages, particularly the role of castles in creating the frontier in the Frankish Latin Kingdoms, see Ronnie Ellenblum, *Crusader Castles and Modern Histories* (Cambridge: Cambridge University Press, 2007), especially chapters 9 and 11.

[13]Burdick et al., *Digital_Humanities*, 16.

humanities in general, but for the environmental sciences.[14] ESRI (the company that makes ArcGIS) has its origins in environmental science, which limits the types of visualizations its software can create for historical mapping.[15] Even more troubling is the fact that GIS technologies privilege epistemological certainty over the ambiguity that lies at the very heart of historical research: historical data must be extracted and divorced from its source context to be integrated into spatial analytical systems. Thus, we begin our discussion by addressing head-on the implications of turning historical sources into data.

When creating maps and visualizations out of data drawn from archival material, every data point derives from a series of historical choices and interpretations. Beginning with our first reading of a text, historians constantly make decisions about reliability and meaning. In practice, all of those decisions can be included in notes, caveats, and explanations in a dataset. But the organization of data requires more rigid boundaries, often making the nuances of historical evidence hard to detect. In the end, historically nuanced data points still often become a point, line, or polygon on a digital map, corresponding to latitude and longitude coordinates that convey greater certainty than the data might merit. Major locations, whose geography has been settled for millennia, are relatively easy to translate from a descriptive text to a modern map (including many of the notable cities – Jerusalem, Rome, Constantinople, Alexandria, Barcelona, London – but also smaller, well-documented cities and locations – Trier, Cartagena, Hippo Regius, and similar ancient locations).[16] However, historical data for the vast majority of places in the pre-modern world is hard to quantify, because the exact location and character of many place references are not always knowable. Consequently, "the precision that is necessary for statistical work does not readily admit the sort of evidence used by most humanists, and when it does, the result, usually in the form of maps, can be highly misleading, implying a certainty that the underlying data do not permit."[17] As a result, major geographic projects – like the Pleiades project,

[14]ArcGIS Online see https://www.esri.com/en-us/arcgis/products/arcgis-online/overview; QGIS see https://www.qgis.org/en/site/ (accessed June 18, 2023).

[15]Alexander von Lünen and Gunnar Olsson, "'Thou Shalt Make No Graven Maps!' An Interview with Gunnar Olsson," in Alexander von Lünen and Charles Travis, eds., *History and GIS: Epistemologies, Considerations and Reflections* (New York: Springer, 2013), 83.

[16]Humphrey Southall has written a set of articles about these issues in English historical GIS. See, especially, Humphrey Southall, "Rebuilding the Great Britain Historical GIS, Part 1: Building an Indefinitely Scalable Statistical Database," *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 44, no. 3 (2011): 149–59; and Idem., "Rebuilding the Great Britain Historical GIS, Part 3: Integrating Qualitative Content for a Sense of Place," *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 47, no. 1 (2014): 31–44.

[17]David J. Bodenhamer, "The Spatial Humanities: Space, Time, and Place in the New Digital Age," in Toni Weller, ed., *History in the Digital Age* (London: Routledge, 2013), 28; Many scholars are even more

based on classical archeology, or the gazetteer of sixteenth-century Spain prepared by Robert Hibberd and J.B. Owens – necessarily include some means of excluding or highlighting uncertainty. Hibberd and Owens give each data point a certainty rating, while the Pleiades Project uses a team of experts to limit data to only highly certain archeological evidence available today.[18] Even marking a road, town, or region as "unreliable" still obscures the historical or textual reasons that ultimately made the label necessary.

Part of this historical difficulty is a problem of scale. To take a related example, though not from mapping, the *Cartae Europae Medii Aevi* (*CEMA*) project uses vast collections of charters to look at historical linguistic developments: specifically, the project looks at the use of specific words across many texts, spatial patterns in usage, and even word patterns in the lexicon of papal, episcopal, or royal documents.[19] The pattern recognition available through deep learning algorithms allows for new observations about the character of charters across huge areas of space and time, but visualizations of large datasets can make the conclusions feel more concrete than would a narrative description of such changes in a typical monograph. In his introductory article to *CEMA*, Nicholas Perreaux observes that even with sophisticated algorithms, the project still rests on existing historical metadata and categories, developed by historians reading hundreds of charters. That is, multiplying the number of sources multiplies the number of interpretations and the ambiguities that go along with those choices: a *larger* historical dataset is still based on historians' interpretative decisions. Consequently, though we can increase the amount of data behind our studies, this in itself does not make them more reliable. The amount of interpretation involved in each data point means that resulting visualizations must be read as being just as contingent as traditional historical studies.

These caveats should not make us hesitant to organize our research as tabular data and use visualizations to present and analyze it. Rather, we must

critical. Rita Raley decries quantitative analysis as, "unthinking and its investments in 'precise measurement' hopelessly naive; the epistemological certainty that data visualization seems to offer is equally fantastic." Rita Raley, "Digital Humanities for the Next Five Minutes," *Differences* 25, no. 1 (May 1, 2014): 26–45 (on pg. 28), https://doi.org/10.1215/10407391–2419991 (accessed June 18, 2023). The practice of mapping itself was never as positivistic as the harshest criticisms imply, and while computer data systems do demand a precision that is not always available from historical documents, statisticians are just as aware of the ways that this precision is illusory even with contemporary information.

[18]For the Pleiades Project, see: https://pleiades.stoa.org/ (accessed June 18, 2023); for the Spanish gazetteer, see: Robert Hibberd and J.B. Owens, "Before Highway Maps: Creating a Digital Research Infrastructure Based on Sixteenth-Century Iberian Places and Roads," *Bulletin for Spanish and Portuguese Historical Studies* 40, no. 1 (2015): Article 2, https://asphs.net/article/before-highway-maps-creating-a-digital-research-infrastructure-based-on-sixteenth-century-iberian-places-and-roads/ (accessed June 18, 2023).

[19]Nicolas Perreaux, "Possibilities, Challenges and Limits of a European Charters Corpus (Cartae Europae Medii Aevi – CEMA)," 2021, hal –03,203,029, https://hal.archives-ouvertes.fr/hal-03203029 (accessed June 18, 2023).

learn how visualizations are produced, and thus how they should be read, and then actively factor that knowledge into our assessments of and reliance on them – just as we do with historical argumentation and narrative. Today we are all familiar with and can interpret standard types of visualization of data such as bar charts, pie charts, and line graphs. But this was not always the case. For example, William Playfair introduced the first modern bar graphs in the late eighteenth century and initially people struggled to read them and interpret their message. In his accompanying text, Playfair himself apologized to his readers for the bar graph's difficulties and limitations.[20] Today, bar graphs routinely appear on the news or in other sources for general audiences. Similarly, choropleth maps (the basic thematic map used for numerous contemporary visualizations, from COVID-19 risk to elections[21]) appeared first in the nineteenth century. The first choropleth map, the *Carte figurative de l'instruction Populaire de la France*, was published in 1826, but it took decades for this visualization technique to become widely used.[22] Network graphs first appeared in physics, drawing on methods from mathematical graph theory, long before they were incorporated into social science research and history. These early analyses are quite distinct from their current use in sociology or the sorts of visualizations and analyses that historians use, especially in regard to social networks and commercial webs.[23] Unlike bar graphs or choropleth maps, network graphs remain the tool of specialists and are quite difficult to read. Nevertheless, we can become literate in reading them in the future. New visual analyses take time to become comprehensible. Researchers must make the effort to learn to interpret the patterns and meanings they represent.[24]

[20] James R. Beniger and Dorothy L. Robyn, "Quantitative Graphics in Statistics: A Brief History," *The American Statistician* 32, no. 1 (1978): 2–3.

[21] For COVID-19 maps see https://link.springer.com/article/10.1007/s42489-020-00057-w and http://travelerslab.research.wesleyan.edu/2020/05/12/covid-19-in-nyc-comparison/; for election maps see https://dsl.richmond.edu/voting/elections.html (accessed June 18, 2023).

[22] Onno Boonstra, "The Dawn of a Golden Age? Historical GIS and the History of Choropleth Mapping in the Netherlands," in von Lünen and Travis, *History and GIS*, 29, 33.

[23] For network visualization for data large or small, Gephy and Cytoscape are appealing places for historians to start. https://gephi.org/; https://cytoscape.org/ (accessed June 18, 2023). One of the early historical uses of network graphs examined marriage patterns and social connections in the Medici family's rise to power; see John F. Padgett and Christopher K. Ansell, "Robust Action and the Rise of the Medici, 1400–1434," *American Journal of Sociology* 98, no. 6 (May, 1993): 1259–319. For two recent overviews of network analysis and early modern history, see Dan Edelstein, Paula Findlen, Giovanna Ceserani, Caroline Winterer, and Nicole Coleman, "Historical Research in a Digital Age: Reflections from the Mapping the Republic of Letters Project," *The American Historical Review* 122, no. 2 (April 2017): 400–24; and Kate Davison, "Early Modern Social Networks: Antecedents, Opportunities, and Challenges," *American Historical Review* 124, no. 2 (April 2019): 456–482. For more on the *Mapping the Republic of Letters* project see http://republicofletters.stanford.edu/ (accessed June 18, 2023).

[24] For an excellent overview of these issues, see John Theibault, "Visualization and Historical Arguments," in Jack Dougherty and Kristen Nawrotzki, eds., *Writing History in the Digital Age* (Ann Arbor: The University of Michigan Press, 2013), 173–85.

The normalization of multiple and constantly evolving visualizations in our work reminds us that maps and graphs are tentative starting places for further research. Any visualization exists to help us express complexity in a productive way; it is an abstraction that helps us better understand social reality. To quote Detlev Mares and Wolfgang Moschek:

> Since GIS does not "draw" maps but helps to visualize data, the potentially preliminary character of GIS-generated maps in teaching contexts means that a continual process of data re-collation is set in motion. A single map produced in an attempt to reconstruct the situation of the past is interpreted and may be immediately deconstructed in the process, giving way to additional data visualizations. Thus, new maps may answer some of the questions they were created to answer, or these maps may call for yet more re-collations of data. By transforming self-generated maps into heuristic tools in the process of answering questions, pupils come to understand that representations of past space are constructions which depend on the perspective inherent in the choice of data. Thus, pupils get a sense of agency and learn to question their preconception about time and space by probing different narratives. This emphasizes the positive dynamics of creating representations of space and time with GIS.[25]

Visualizations are thus not *just* arguments, *but also* methods of thinking and researching. The construction of a map sends us back to do more research and spend more time on interpretation, similar to the process of exploratory data analysis originally described and championed by John Tukey.[26] It is self-evident but bears repeating: there is no final map that will represent a final past. Visualizations are a means, not an end. And often, visualizations are simply a means to a new visualization.

What do all of these caveats mean for how we produce and use visualizations of all kinds for historical study? And, why should we produce visualizations if we can never capture everything? The first step is to realize that visualizations are simply tools to show patterns (in our case spatial patterns) based on available data. Johanna Drucker has famously challenged scholars to accept this in historical mapping by normalizing an approach whereby less realistic forms of visualization – what she calls "non-representative cartography" – emphasize the non-naturalness of the data.[27] (The Tree Map in Figure 1 below exemplifies such non-natural cartography). This approach would involve decisions as simple as resisting the urge to fill in parts of the

[25]Detlev Mares and Wolfgang Moschek, "Place in Time: GIS and the Spatial Imagination in Teaching History," in von Lünen and Travis, *History and GIS*, 66.
[26]See John Tukey, *Exploratory Data Analysis* (Reading, MA: Addison-Wesley, 1977).
[27]Johanna Drucker, "Non-Representational Approaches to Modeling Interpretation in a Graphical Environment," *Digital Scholarship in the Humanities* 33, no. 2 (June 2018): 248–63; and see also Johanna Drucker, *Graphesis: Visual Forms of Knowledge Production* (Cambridge: Harvard University Press, 2014), 125–37.

map where there is still uncertainty or to exclude conjectural elements, like state borders, in historical maps. We might also eschew a high level of detail for natural elements that have changed over time, such as rivers and forests; we can give graphic elements fuzzy edges; we can use unnatural colors and perfectly straight lines to help take the viewer out of the sense of naturalness (and therefore authority). As Anne Kelly Knowles notes, it is this very clarity and naturalness that creates maps "behind whose veneer of professionalism may lie all manner of unseemliness."[28] Removing that veneer is a great step toward making our visualizations *look* more like our actual research. While historical maps do not necessarily need to be less professional, they can certainly stand to be sparser and less familiar.

The challenge for historians is how to develop approaches to visualizing historical spaces that disrupt their perceived authority while tracing out a path toward better and more humanistic data. This is not a new challenge, but it is one more of us need to take up. Criticism of the overly positivistic responses to maps has also been part of discussions within geography for decades.[29] In fact, notable historians who have worked extensively with computer-based mapping have proposed methods for creating just such new and experimental spatial representations. Levi Westerveld and Anne Kelly Knowles' recent work on Holocaust survivor narratives has used more experimental visualizations of space, specifically as a response to the overly structured and positivist characteristics of GIS software.[30] Monica Wachowicz and J.B. Owens have written about the need for new paradigms (proposing a system of "knowledge spaces") along with more innovative data-structures to make GIS truly work for historians.[31]

When we approach visualization in general and mapping in particular as an experiment in geo-temporal historical representation, we begin to realize that these tools offer us powerful new ways of understanding and considering the

[28]Anne Kelly Knowles, "GIS and History," in Anne Kelly Knowles, ed., *Placing History: How Maps, Spatial Data, and GIS are Changing Historical Scholarship* (Redlands, CA: ESRI Press, 2008), 19.

[29]While such critiques have long been part of the discussion of maps and mapping, the contemporary debate around maps as purveyors of ideological power has been more central since the publication of J. B. Harvey's article, "Deconstructing the Map," *Cartographica: The International Journal for Geographic Information and Geovisualization* 26, no. 2 (Summer, 1989): 1–20; for other recent critiques along these lines, see Denis Wood with Jon Fels, *The Power of Maps* (New York: Guilford Press, 1992); Denis Wood and John Fels, *The Natures of Maps: Cartographic Constructions of the Natural World* (Chicago: University of Chicago Press, 2009); and Marianna Pavlovskaya and Kevin St. Martin, "Feminism and Geographic Information Systems: From a Missing Object to a Mapping Subject," *Geography Compass* 1, no. 3 (2007), online: https://doi.org/10.1111/j.1749–8198.2007.00028.x (accessed June 18, 2023).

[30]Levi Westerveld and Anne K. Knowles, "Loosening the Grid: Topology as the Basis for a More Inclusive GIS," *International Journal of Geographic Information Science* 35, no. 10 (2021): 2108–27.

[31]Monica Wachowicz and J.B. Owens, "The Role of Knowledge Spaces in Geographical-Oriented History," in von Lünen and Travis, *History and GIS*, 127–44.

past. The key component of mapping for historical study lies not in their structuring of older data to fit modern cartography, but rather in allowing us to amalgamate large quantities of data and experiment with the many different and unique patterns that exist within it. We highlight two different approaches currently being taken in experimental mapping and visualization: the teasing out of geographic references within a single large or important text (or perhaps a small collection of important texts), and the dredging up of hundreds of locational references from large document collections similar to the text analysis of large corpora. Both types of research are crucial to understand our specific shared interest of mobility in the past. For example, projects on travel writers, who provide a natural geographic focus – Marco Polo, John de Mandeville, Ibn Battuta, and other travelers – have produced various types of maps and visualizations from their writings. It is no accident that these projects are often associated with teaching materials rather than research.[32] The ongoing project to map monasteries across the Iberian kingdoms also illustrates well the goals and methodologies involved in aggregating massive amounts of data from highly diverse sources.[33] Robert Hibberd and Jack Owens' project to digitize the sixteenth-century itinerary of Spain by Juan Villuga referenced above is an early and excellent version of this approach in mapping multiple descriptions of the same routes.[34] In other cases, scholars have carried out "spatialization," taking original sources or texts of varying types that contain information with a spatial component.[35] These are just a few examples of how creative and experimental visualization can allow us to touch some of the unsolvable mysteries of the past such as the extensive networks

[32]For Ibn Battuta, see *The Travels of Ibn Battuta*, at Berkeley University: https://orias.berkeley.edu/resources-teachers/travels-ibn-battuta; for Marco Polo, see *Imagining Medieval Narrative: The Travels of Marco Polo*, at Vanderbilt University: https://scalar.usc.edu/works/the-travels-of-marco-polo/index; or *Mapping Polo*, by Tomasso Pepe, https://www.mappingpolo.com/; for John Mandeville, see the "Mapping Mandeville Project," at *Historia Cartorum* by John Wyatt Greenlee: https://historiacartarum.org/john-mandeville-and-the-hereford-map-2/; though the actual program no longer works, MIT layer-cake visualization of Ibn Juybar's pilgrimage to Mecca is another strong example of visualization https://libraries.mit.edu/akdc/2017/02/19/akdc-debuts-new-tool-layer-cake/. Chelsea Skalak, "Mapping the Global Middle Ages: Diversifying the Classroom with GIS," *The Once and Future Classroom: Resources for Teaching the Middle Ages* 15, no. 1 (Spring 2019): 57–77, https://teams-medieval.org/chelsea-skalak-mapping-the-global-middle-ages-diversifying-the-classroom-with-gis/ (accessed June 18, 2023).

[33]The *Claustra* project: http://www.ub.edu/claustra/spa/Monestirs/atles (accessed June 18, 2023). An older and thus more well known example is the *Mapping Past Societies* project at Harvard University (formerly, the Digital Atlas of Roman and Medieval Societies) which has digitized the massive Barrington Atlas of the Greek and Roman World, https://darmc.harvard.edu/ (accessed June 18, 2023).

[34]See Hibberd and Owens, "Before Highway Maps."

[35]In contemporary visualizations, "spatialization" can also refer to the use of non-geographic, but dense or multidimensional data to create spatial "maps" as a particular mode of visualization, see André Skupin and Sara Irina Fabrikant, "Spatialization Methods: A Cartographic Research Agenda for Non-geographic Information Visualization," *Cartography and Geographic Information Science* 30, no. 2 (April 2003): 99–119.

that lay behind quotidian and spectacular human mobility, from trade to war, communication, pilgrimage, migration, and much else.

## Part 2: mapping travel

In the maps that follow, we seek primarily to demonstrate various mapping and visual outputs using GIS programs as well as data analysis programming languages such as R and Python.[36] In the process, we believe that our various visualizations from Byzantine, Spanish, English, and Italian sources will offer readers some idea of how to use visualizations to make an historical argument.[37] Though our maps come from different times and places, they provide tentative insights into the nature of medieval travel. Our first examples map geographical references from an important Byzantine Roman text. These images provide two ways of visualizing what one text can tell us about what people knew of distant places. The second series of maps uses locational references from itineraries to construct road networks in Spain. Our visualizations compare medieval data with previously mapped road systems to provide insight into how people actually moved between cities and towns. We then have two sets of maps with monastery points in both Spain and England to show different types of analysis that can be generated in GIS using simple points. Monasteries were points of departure, destinations, and waystations for travelers. These maps then provide some insights into the medieval infrastructure that facilitated travel along road networks as well as the spatial thinking of people in the past. We then look at actual travelers – English bishops – using an innovative visualization (Ling Pillars) to examine individual travel over time. Our final map is based on a large mercantile letter collection – the Datini Company archives. Mapping the spatial and temporal movement of such a large body of letters (more than 100,000 currently preserved in the archive) allows us to measure various aspects of the Datini Company's communication network, including average speeds, reliability, and seasonal changes.

[36] In our own work, we try to remain agnostic about the specific tools. Data analysis and mapping tools are constantly changing as new systems are developed and expanded. R and Python are data analysis standards for the moment, but we have also made use of other programs such as Recogito's open-access mapping interface (https://recogito.pelagios.org/) or MAXQDA's qualitative text analytics (https://www.maxqda.com/) whenever they prove useful (accessed June 9, 2023).

[37] For an excellent example of using spatial analysis to reframe the historiographical debate over Frankish segregation vs. Frankish assimilation in the crusader kingdoms, see Ronnie Ellenblum, *Frankish Rural Settlement in the Latin Kingdom of Jerusalem* (Cambridge: Cambridge University Press, 1998), especially the maps on pages 223, 226–228, 258, 266–267, 270–271. Ellenblum shows through mapping that Franks largely settled in places with substantial local Christian populations and refrained from living among Muslims and Jews. His spatial analysis indicates a middle ground in the debate by highlighting integration with Eastern Christians and separation from Muslims (251, 282–3, 285).

This smorgasbord approach precludes a single historiographical intervention here. Nonetheless, our goal is to demonstrate how a heuristic approach to visualizations can provide tentative answers to questions that would be harder to address without visualizations. For instance, how far did people travel? Where did they go? What kinds of connections existed between places in the past? How was the infrastructure of travel organized and how did it facilitate travel? What did people know about distant places and where were they interested in going? Even without definitive answers, we generated historical insights: there was more mobility than we realized, and people on the move created new travel networks that did not follow Roman roads. We asked these questions by using GIS and other tools, not to make definitive or settled maps, but as a scratchpad to explore our historical data and to combine aspects of it in multiple ways, to create new ideas and to advance our historical research by proposing new knowledge about the past.[38]

Our first example comes from the "Narrative and Geography in the *Chronicle* of Theophanes" project.[39] We began studying this ninth-century history of the universe in a lab devoted to travel and movement because a preliminary analysis identified that approximately 20% of the text related in some way to geography, to orienting its audience's understanding of their place in the world.[40] Our lab's Theophanes project then collected this geographic data from the text and tallied the frequency of mentions of each geographic item. Building from the premise that we do not know what the world *looked* like in the mental imagery of a ninth-century Constantinopolitan (the original audience), we used the same data to both create visualizations that could serve as translations of the settlements mentioned in the text into modern conceptions of geography – and so *look* sensible to us, today – and also to create visualizations that might convey a more indigenous sense of how the text may have shaped a ninth-century reader's idea of what was *near to* and *far from* the historical interests of Constantinople.

[38]Alexander von Lünen, "Tracking in a New Territory: Re-imaging GIS for History," in von Lünen and Travis, *History and GIS*, 232, 235.

[39]https://travelerslab.research.wesleyan.edu/theophanes/ (accessed June 18, 2023). On the text itself, see the critical edition by Karl de Boor, *Theophanis Chronographia* (Leipzig: Teubner, 1883), the critical translation by Cyril Mango and Roger Scott, *The Chronicle of Theophanes the Confessor: Byzantine and Near Eastern History, AD 284–813* (Oxford: Oxford University Press, 1997), and the recent critical study by Jesse W. Torgerson, *The Chronographia of George the Synkellos and Theophanes: the Ends of Time in Ninth-Century Constantinople* (Leiden: Brill, 2022).

[40]This ratio was determined by reading quickly through the Chronicle and using the qualitative analysis tool MaxQDA (https://www.maxqda.com/) to highlight sentences that had a significant focus on where something happened rather than on what happened or the character of the persons involved and other such editorializing commentary.

The following map drawn by Jesse Simmons (Map 1) places the 353 human settlements (city, fort, monastery, palace, etc.) mentioned over the course of the *Chronicle* onto a modern geographic projection of the Mediterranean.[41]

The settlements are colored differently for the emperor under whom they appear, and are sized according to the number of times they are mentioned under that emperor. This projection can tell scholars something (in terms familiar to us) about the concentration of the *Chronicle*'s urban geography in the coastal Eastern Mediterranean; an important and useful starting place for further research questions.

The following image (Figure 1) represents the exact same data as in Map 1 —the mentions of all 353 settlements in the *Chronicle*—but purely in terms of frequency of mentions in the text rather than in terms of "actual" geographic distance.

Instead of plotting these mentions geographically, the frequency with which each settlement was mentioned in the *Chronicle* determined its relative size and distance from the "center" (upper left) to the "periphery" (lower


**Map 1.** Settlements mentioned in *Chronicle* (drawn by Jesse Simmons in ArcGIS).

[41]Data publicly available here: https://github.com/The-Travelers-Lab/Theophanes-Geography-Project/blob/master/Datasets/Years_Place_Settlements%20(wide%20version).csv (accessed June 18, 2023).

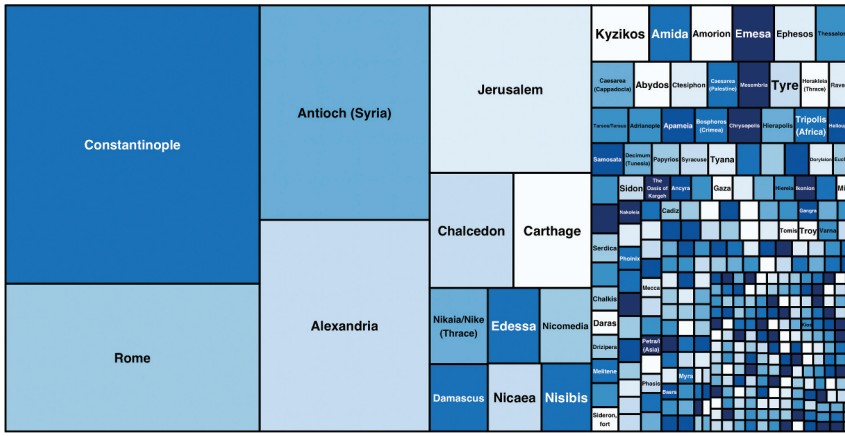



**Figure 1.** Tree map of settlements in the *Chronicle* of Theophanes by frequency each is mentioned (created by Pavel Oleinikov in R studio).

right).[42] The cardinal nodes of the world in the tree map are clearly Constantinople, Antioch, Alexandria, Rome, and Jerusalem, with the rest of the urban topography of the empire radiating out from that central quadrant of narrative significance. This *Tree Map* visualization might be said to present narrative proximity in the text, or even imply a perceived political, or historical proximity between Constantinople and each other settlement. We might now consider tackling the question of whether frequency denotes power, influence, or something else, each of which could become productive research questions with which to return to the data and, of course, to the text itself.

It is also the case that while most cities have very few mentions, if we were to pursue an investigation grouping cities by provinces (for example), a completely different picture would likely arise. To this end, Figure 2 shows how we might next alter the visualization to begin tackling such a question: by grouping together settlements with similar total mentions, we can create "provinces" of cities nearer or farther from the narrative center of the historical text.

The same "geographic" data can therefore be used to help us re-shape our understanding of ancient or medieval conceptions of the space of the world by presenting multiple visualizations as unique experiments.

[42]"Mentions" were tallied manually rather than with a text-search function in order to be able to tally not only explicit namings of settlements ("Constantinople") but also the use of demonstratives to refer to specific locations ("there," "that city," etc.). This work was performed by lab members Ethan Yaro and Nathan Krieger and checked by Jesse W. Torgerson.

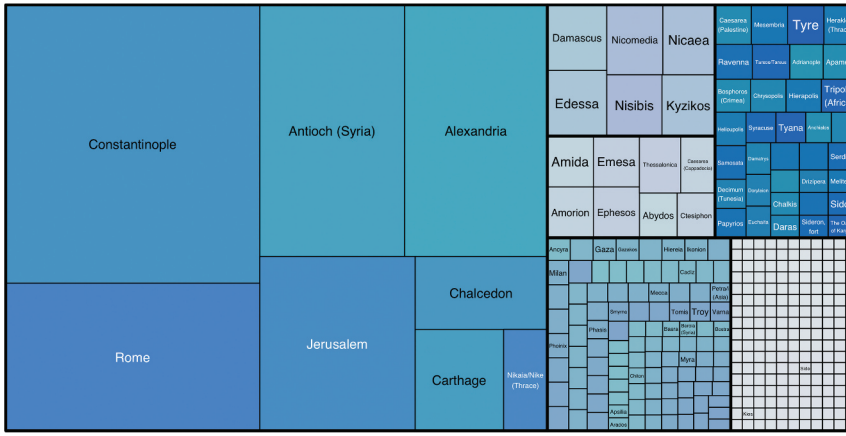



**Figure 2.** Settlements in the *Chronicle* of Theophanes grouped by shared frequency of mentions (created by Pavel Oleinikov in R studio).

These visualizations force us to think about places differently than we have been conditioned (and condition ourselves) to do, and so prompt us to productively reconsider our work and our materials.

People did not just read about distant places; they also traveled to them. Sealanes and roadways facilitated this travel. Here we want to look at road networks in Spain. Let us start with the aforementioned Villuga itinerary, which scholars have studied for many years using both hand-drawn maps and digital mapping tools. Villuga's guide listed various routes to markets, shrines, and other notable places in the Iberian Peninsula in the early sixteenth century. However, Villuga did not make an actual road map. His guide listed places along the route (A to B to C) and the number of leagues between each place.[43] The map of the Villuga road network only provides an approximation of the routes, as the straight lines between places mentioned do not correspond to actual roads. Therefore, the Villuga road network is helpful for small-scale maps, but the lines are not accurate for zooming into specific locations (i.e. large-scale maps).[44] The use of straight lines can also lead to the misrepresentation of the actual distance between places as routes often

[43]For earlier work with hand-drawn maps, see Gonzalo Menéndez Pidal, *Los caminos en la historia de España* (Madrid: Ediciones Cultura Hispánica, 1951). For more on the creation of the digital road map from Villuga, see Hibberd and Owens, "Before Highway Maps." Of course, the number of miles or kilometers that constituted a league was not standard in the early modern period, which raises further questions about mapping and distance based on itineraries. See Sylvia Sellers-Garcia, *Distance and Documents at the Spanish Empire's Peripheries* (Stanford: Stanford University Press, 2014), 96–100.

[44]The *Viabundus Pre-Modern Street Map*, (https://www.landesgeschichte.uni-goettingen.de/handelsstrassen/index.php) (accessed June 18, 2023), a more recent project, also uses reported trips, but instead of

meandered and included travel over rough terrain. Some scholars have recently tried to address this road-mapping problem through a roughness index – "the number of contour curves crossed by the path divided by the length of the section." Travel times in rough areas were generally slower than elsewhere.[45]

These facts are important to keep in mind when considering mobility, especially what Fernand Braudel calls the "the arithmetic of distances, the average speed of travel along roads, the normal length of voyages."[46] Oftentimes, frequency and speed create the distances, not actual geography.[47] It is hard to calculate actual travel times, especially as we often only know about the fastest travelers. For instance, the postal service on the Italy-Brussels route, via Tyrol, covered about 86 miles a day, while a fast galley could cover 124 miles or more a day.[48] Yet, most travel was slower – around 17.4 miles for a day's walk in the Middle Ages. Today, riders often plan on 20–30 miles a day for a long journey on horseback. The lower end of this daily distance was likely true for most horsemen in the Middle Ages as well.[49] With these details in mind, what can we learn from the Villuga road network?

coming from a single work like the Villuga itinerary, the dataset is an aggregate of hundreds of small references to single trips taken by merchants, couriers, or other local travelers, especially among the many towns and cities in the network of the Hanseatic League. The original data for the project come from the 1962 atlas, the *Hansische Handelsstraßen*, but the project collaborators are continually adding new data. Like the digital Villuga project with its data points certainty rating, the *Viabundus* dataset indicates levels of certainty for all elements. This is especially important because some of the roads are reconstructed using likely routes and even LIDAR data to guess at likely historical paths that are only attested to in single sources. Moreover, as Paddington Hodza and Kurtis Butler have shown for Roman roads in Italy, any attempt to extrapolate a more "real" path from the incomplete archeological record for ancient transportation routes remains an interpretation. As noted in part one, the perceived precision of GIS can conceal these interpretations. Therefore, it is important to highlight such choices in our datasets and maintain good metadata embedded in the map so the interpretive choices can be evaluated. Paddington Hodza and Kurtis A. Butler, "Juxtaposing GIS and Archaeologically Mapped Ancient Road Routes," *Geographies* 2 (2022): 48–67, https://www.mdpi.com/2673–7086/2/1/5 (accessed June 18, 2023).

[45]Federico Pablo-Martí, Ángel Alañón-Pardo, and Angel Sánchez, "Complex Networks to Understand the Past: The Case of Roads in Bourbon Spain," *Cliometrica* (October 2020), see fig. 6, https://doi.org/10.1007/s11698-020-00218-x (accessed June 18, 2023).

[46]Fernand Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II*, vol. 1, trans. Sian Reynolds (New York: Harper & Row, 1973), 282.

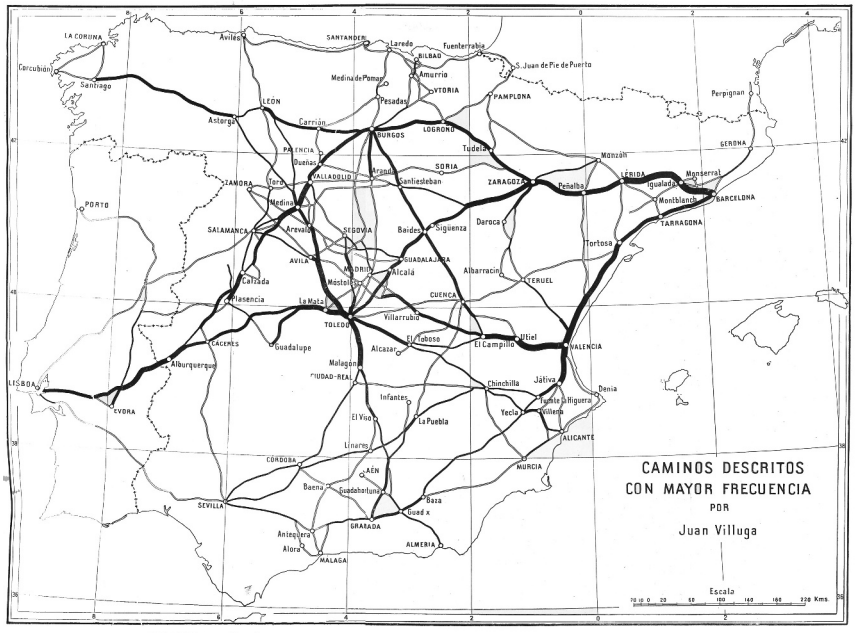
[47]For an attempt to study communication costs along the main routes of the Roman Empire (including at different times of the year), see the innovative Orbis project at Stanford University. https://orbis.stanford.edu/ (accessed June 18, 2023).

[48]Braudel, *Mediterranean*, 358–59.

[49]Pascual Martínez Sopena, "El Camino de Santiago y la articulación del espacio Hispánico," in Javier García Turza, ed., *El Camino de Santiago y la sociedad medieval* (Logroño: Instituto de Estudios Riojanos, 2000), 71 n.19; For horses, see https://horseracingsense.com/how-far-can-a-horse-travel-in-a-day/ (accessed June 18, 2023). As a point of comparison, in 1993, Charles Blackmore's expedition through the Taklamakan leg of the Silk Road with camels covered 780 miles in 59 days, averaging just over 13 miles a day. See Valerie Hansen, *The Silk Road: A New History* (Oxford: Oxford University Press, 2012), 9–10.

First, many of these routes overlapped. As early as the 1950s, Gonzalo Menéndez Pidal created a map to weigh the most frequently described overlapping routes in the guide (a reminder that sometimes digital tools make existing geographic techniques more accessible or more scalable, rather than inventing entirely new methods). In his map, lighter or heavier lines indicated the number of mentions in the guide (see Map 2).[50] For Braudel, the concentration of heavy lines in Toledo indicated that Toledo "was the traffic center and therefore the most diversified city of the Peninsula."[51] Here Braudel uses the internal data from the guide to reach a larger conclusion about travel in the first half of the sixteenth century; a conclusion that likely holds for earlier time periods, since these routes likely dated back to the late Middle Ages.[52]

Building on such earlier efforts, maps of earlier travel can also provide evidence for changing patterns of road use using significantly larger datasets.




**Map 2.** Roads most frequently described in Villuga's itinerary from Menéndez Pidal.

[50]Menéndez Pidal, *Los caminos en la historia de España*.
[51]Braudel, *Mediterranean*, 279.
[52]For an innovative study that uses 85 itineraries to examine early modern European connections between cities, see Rachel Midura, "Itinerating Europe: Early Modern Spatial Networks in Printed Itineraries, 1545–1700," *Journal of Social History* 54, no. 4 (2021): 1023–63.

Digital work like the *Viabundus* project or Mercator-e have attempted to document the changing economic and political connections that roads imply, starting with the well-documented Roman systems, and attempting to trace these changes through to the early modern period.[53] Using the itinerary of King Jaime II of Aragon (1291–1327), the overlap of the royal travels with the Villuga map provides additional evidence and dating for shifts in use. Royal travel at the end of the thirteenth century focused on a large triangle running from Barcelona to Valencia along the coast (through Tarragona and Tortosa), inland from Valencia to Zaragoza via Teruel, and finally the route from Zaragoza back to Barcelona via Lerida.[54] Two of the sides of this triangle (the coastal route and the road between Zaragoza and Barcelona) appear as important axes of travel both in Jaime's early fourteenth-century movements and in the Villuga guide over two centuries later.

While the coastal route often used sections of Roman road, the third side of the triangle path from Valencia to Zaragoza via Teruel also shows how large medieval road-building projects could supersede Roman construction. In 1265, Jaime I (1213–1276) constructed a new road linking Sagunto to Teruel, via Segorbe and Sarrión.[55] While some sections had Roman paths along the route, the more common Roman road from Valencia to Teruel essentially followed the Turia river valley inland toward Ademuz and from there northward to Teruel. Jaime II (Jaime I's grandson) made extensive use of the newer road. In fact, his itineraries suggest Jaime II never took the older Turia valley route (see Map 3). It is hard to know how popular the new road was with non-royal travelers. However, the new road remained important into the early modern period, as the primary path from Valencia to Teruel.

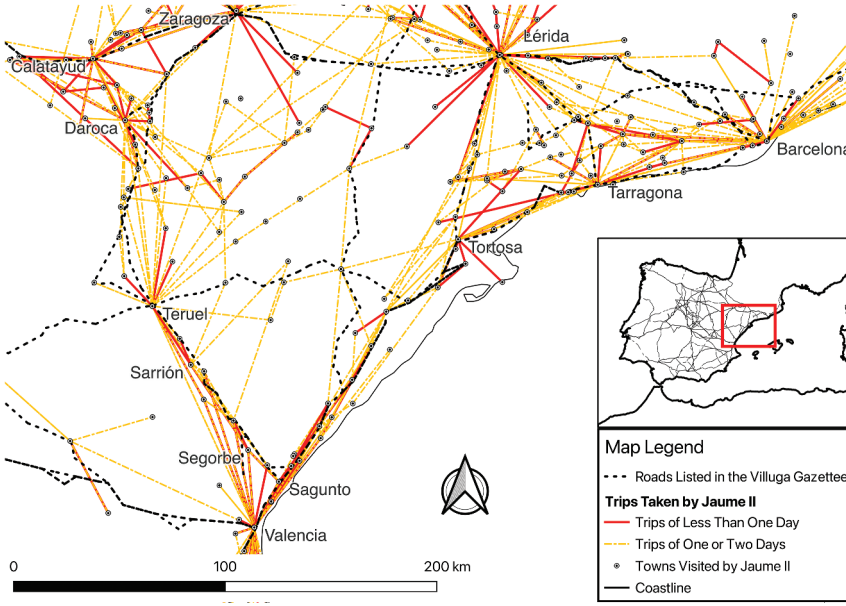
In this instance, the actual movement of medieval people provides evidence of the actual use of non-Roman routes that supports documentary evidence of new road construction.[56] The overlay of multiple small trips

[53]The *Viabundus* project is described above in footnote 44; the Mercator-e project is run by Pau de Soto at the Universitat Autònoma de Barcelona and Daniel Alves at the Universidade NOVA de Lisboa; see http://fabricadesites.fcsh.unl.pt/mercator-e/ (accessed June 18, 2023).

[54]The itinerary was created and published using the dense documentation from the *Arxiu de la Corona d'Aragó*, published by Juan Manuel del Estal, *Itinerario de Jaime II de Aragon (1291–1327)* (Zaragoza: Institución «Fernando el Católico» C.S.I.C, 2009); available online: https://ifc.dpz.es/recursos/publicaciones/28/86/_ebook.pdf (accessed June 18, 2023); Thomas Nuhfer and Alex O'Pray assisted in translating del Estal's research into the data used for the map while they were students at Marlboro College.

[55]Antoni Riera Melis, "La red viaria de la Corona Catalanoaragonesa en la baja edad media," *Acta Historica et Archaeologica Mediaevalia* 23–24 (2002): 454–55; For more on the ancient Roman road network in Iberia see, Viator-e, a current digital project seeking to compile the road networks in the western provinces of the Roman Empire. https://viatore.icac.cat/ (accessed June 18, 2023).

[56]Riera Melis, "La red viaria," 462–3; these findings also broadly agree with the visualizations produced by Mercator-e, see http://fabricadesites.fcsh.unl.pt/mercator-e/results-2/medieval-roads/ (accessed June 18, 2023).




**Map 3.** Detail of Jaime II's royal itinerary with Villuga road.

would be difficult to detect in a written account of the king's travels over decades, let alone in the individual documents that sometimes indicate only a small component of overall mobility. The extensive travel (Jaime II traveled nearly one hundred miles every week) could support other areas of inquiry, as well. Many medieval rulers had similar itineraries, which can shed light on how the court maintained political connections.[57] It can also offer a glimpse of when and how the court interacted with ordinary people – many of the towns the king stayed in had at most only a few thousand people, so the king's entrance would have been a significant event. Maps generated from travel itineraries help us focus our research on locations whose importance might be missing, especially in chronicle evidence.

By reconstructing the road networks of the late medieval world, our work and other road network projects try to understand the physical connections and the economic integration of the time, as well as the influence of transportation networks on political decision making. Studying the time and

[57]This work has been especially important in research on earlier medieval kings; see John Bernhardt, *Itinerant Kingship and Royal Monasteries in Early Medieval Germany, c. 936–1075* (Cambridge: Cambridge University Press, 2002); and Rosamond McKitterick, "A King On The Move: The Place of an Itinerant Court in Charlemagne's Government," in Jeroen Duindam, Tülay Artan, and Metin Kunt, eds., *Royal Courts in Dynastic States and Empires: A Global Perspective* (Leiden: Brill, 2011), 145–69.

distance traveled can also shed light on the transportation costs and efficiency of communication at the time. The combination of these projects will undoubtedly offer powerful tools for addressing and exploring these questions and provide a strong core of reference material for future research on mobility. The creation and use of royal roads in the Crown of Aragon indicate changing population dynamics, commerce patterns, and strategic interests. Finally, in Spain, many roads were maintained by municipal governments. These roads then served the economic interests of the localities, and the growth of road networks in Iberia from roughly 6,214 miles in the Roman period to roughly 11,806 miles in the early modern period suggests changing transportation patterns and growing communication networks. Mapping road networks should then help us to consider more thoroughly the interconnectedness of places in the past.[58]

Through mapping, we can begin to trace the hospitality/accommodation available to medieval travelers. After all, without infrastructure, travel would have been even more arduous than it already was. Monasteries and other religious institutions provided vital resources for travelers. For example, in 1459, the cathedral chapter of Burgos provided alms to an unnamed Greek gentleman returning from Santiago de Compostela.[59] In turn, travel (in this case pilgrimage) provided the impetus and finances for building infrastructure along pilgrimage routes.[60] For example, combining a data layer on monasteries with the Villuga Road line that corresponds to the Camino Frances or French Way (using a 5-mile buffer[61]) provides a starting place to begin a larger study of monasteries and hospitality along the pilgrimage route to Santiago de Compostela (the *Camino de Santiago*).[62]

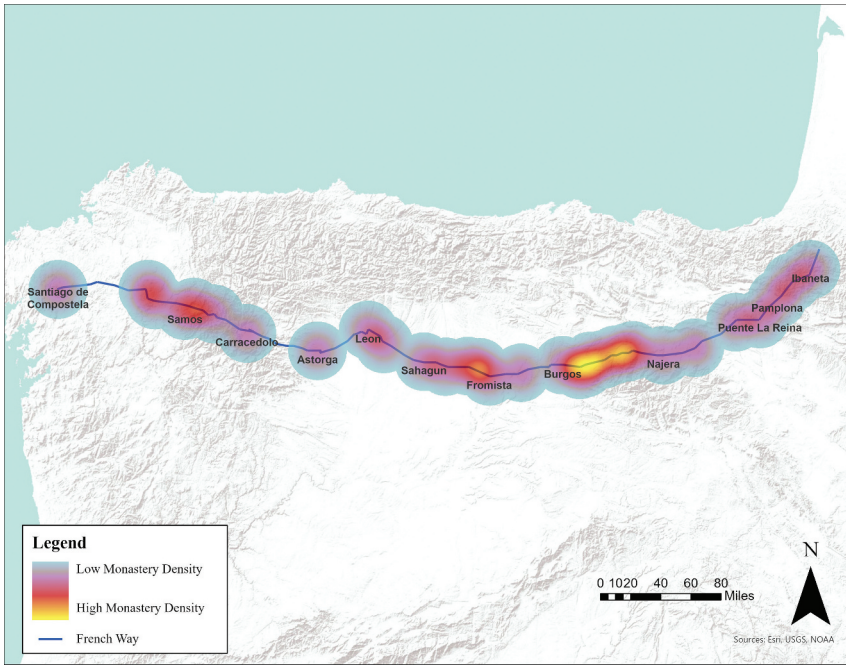
[58]David Alonso García, "Corte, red viaria y sistemas de comunicaciones en la España de Carlos V," in Ludolf Pelizaeus, ed., *Les villes de Habsbourg du XV^e^ au XIX^e^ siècle: Communication, art et pouvoir dans les réseaux urbains* (Reims: ÉPURE, 2021).

[59]See https://www.fundacioncajacirculo.es/AHCB_D.php?cod=7040RR&nombre=Limosna (accessed June 18, 2023).

[60]Adrian R. Bell and Richard S. Dale, "The Medieval Pilgrimage Business," *Enterprise and Society* 12, no. 3 (September 2011): 601–24.

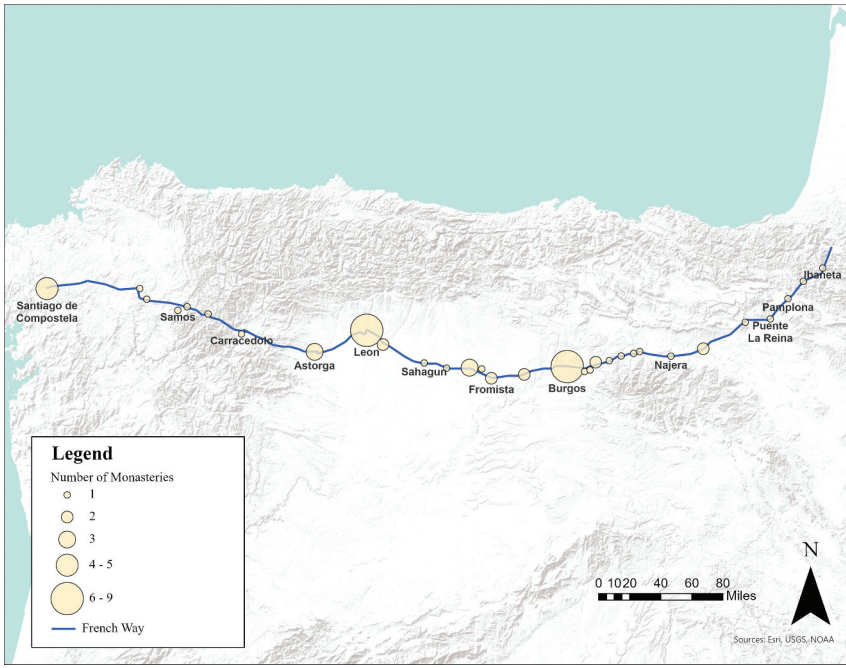
[61]Buffer tools are a feature in GIS programs that create polygons based on a set distance from a point, line, or polygon. Buffers are useful for proximity analysis to determine whether features fall inside or outside the buffer or to determine the mean distances from a single point. For example, how many monasteries are within five miles of the Camino (above) or how many monasteries are within a series of 20 mile intervals of a central point (below). For a more thorough discussion of the use of buffers in historical research, see Gregory and Ell, *Historical GIS*, 76–79.

[62]The monastery layer was created from two sources. Archival documents regarding monasteries that contributed to the ecclesiastical subsidy in the early sixteenth century and data culled from a gazetteer. See Archivo General de Simancas, Comisaría de Cruzada, legajos 1–5, and Annie Shaver-Crandell and Paula Gerson, with the assistance of Alison Stones, *The Pilgrim's Guide to Santiago de Compostela: A Gazetteer* (London: Harvey Miller Publishers, 1995). The following Saint Anselm College students helped to develop the *Camino* dataset and maps: Emma Bickford, Brodie Deshaies, Madison Lessard, Katherine Menice, Claire Ridley, and Audrey Wetjen.




**Map 4.** Heat map of monasteries along Camino Frances.

According to our dataset, thirty-one towns along the Way had monasteries. We have used two methods to visualize the same data. The heat map (Map 4) indicates a high concentration of towns with monasteries near Burgos and between Sahagun and Carrión de los Condes. The only area with a notable absence of monasteries is in Galicia. The heat map effectively shows where fewer monasteries were. Most towns only had one monastery, but a few larger cities, like Burgos, Leon, and Santiago, had multiple (Map 5). This graduated symbol map (a type of dot distribution map) helps to illustrate this point. Our dataset also could generate maps showing monasteries by religious orders or by male/female houses. That is, we can easily use GIS to create multiple layers from the same dataset, and each iteration of the data offers new insights or raises new questions. Here, though, we want to look at the concentration and spacing of monasteries along the route. Digital technology also allows us to calculate distance. Using absolute distances, or distances "as the crow flies," the average distance between towns with monasteries was 13 miles. The closest was 2.5 miles and the longest was 44. Depending on the actual trajectory of the route, most pilgrims would have passed at least one monastery almost every day of their journey across northern Spain. However, this is just a snapshot. It does not tell us which




**Map 5.** Number of monasteries per town along Camino Frances.

monasteries accepted guests, when houses were founded or dissolved, and if they were actually visited by pilgrims.

Nonetheless, these monastery points provide a starting place to consider the built environment that pilgrims would have encountered, and combining this map with itineraries of pilgrims might help us better understand how infrastructure – such as monastery and hospitals – facilitated travel. Most studies of monasteries focus on individual houses or particular orders or regions. There is no single source to study the 58 known monasteries along the Spanish portion of the Camino that our spatial analysis reveals. Consequently, the dataset generated from this map can be exported and elaborated based on secondary studies of these monasteries to examine more thoroughly the development of the Camino infrastructure over six centuries. Digital technology allows us to link granular details to the Camino's physical geography and to create a "deep map" of the infrastructure over time.[63]

[63]For more on the infrastructure of the Camino, see Sean T. Perrone and Carol Traynor, "Mapping the Way of St. James: GIS Technology, Spatial History, and the Middle Ages," *Church History and Religious Culture* 101 (2021): 3–32 and for various layers of the infrastructure see https://www.arcgis.com/apps/View/index.html?appid=686ab9f3f4924c1ab3ce68e40744b73d (accessed June 18, 2023).

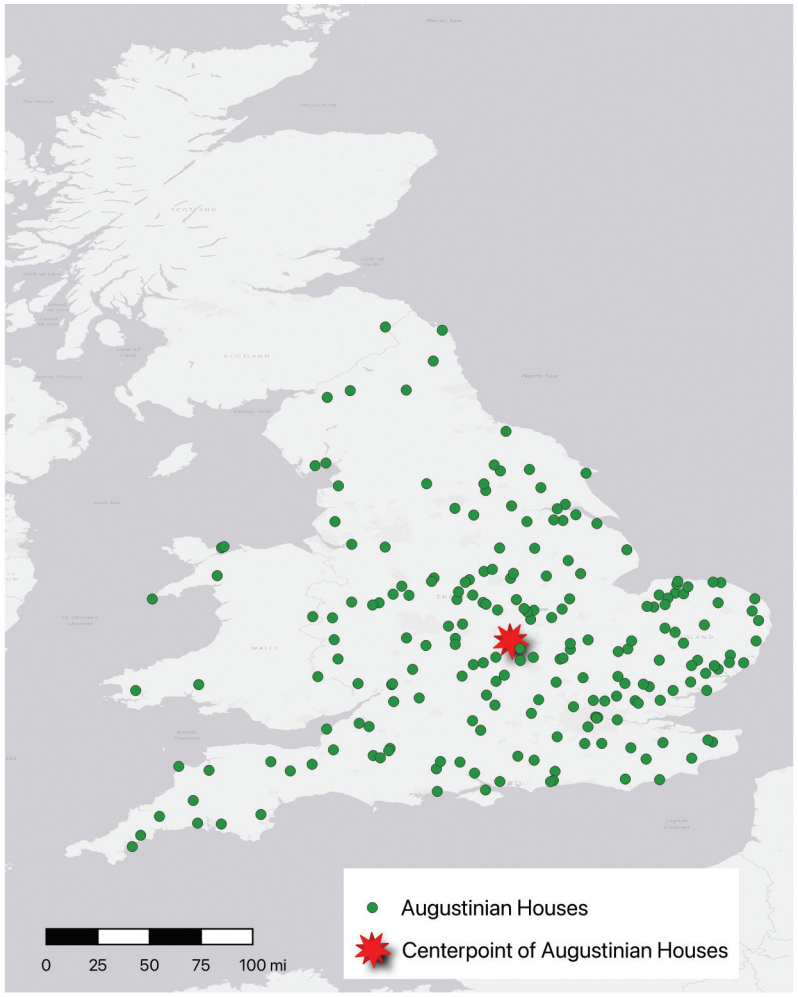
Maps of transportation and transit routes may also help us to understand other developments in the period. Transit routes and routines reflected institutional priorities and practices. For instance, from the thirteenth century, the Catholic Church sought to have all religious orders hold conventions for self-governance and regulation every three years. For some select groups, mobility became a structured part of monastic life. It is one thing to know the new decree, another to understand the scope of its impact. How did people handle this in practice? If we look at the case of the Augustinian Canons, the order with the most monastic locations in England, we can see how they coped.

In Map 6, we see the full geographic range of 207 houses established by the Augustinians.[64] The impressive geographic extent only becomes clear when we map them. Mapping as you work is a process of simple revelation of patterns within the sources. After the mandate to meet as a group, however, the map is dynamized and we must understand the houses as periodic distributed points of collective departure. The canons came from all over the country but, interestingly, they figured out the zone of optimal collective travel. The map's star indicates the geographic center of all their houses, a place that they cannot have known or discovered except through experience and discussion.

In Map 7, we add further information that shows all the Augustinian houses and gives an indication of how far they were from the locations selected for the regular meetings of the order and the geographic center of their meeting sites. We ran this analysis *because* the previous map suggested travel distance and fairness were likely an issue.

Map 7 shows how a knowledge of location and the challenges of distance and fairness pressed toward an outcome that structured considerable travel. It indicates both the geographic center of the Augustinian houses and the places where the Augustinians actually met. It is striking how close the two center points are: fewer than ten miles apart. The Augustinians meant to produce a sort of equity of average travel and they succeeded in that. Clearly minimizing average travel distance was one goal. In the period examined here, only seven locations were selected for general meetings, all in midland or south central England. The median house was a little under 80 miles away, admittedly as the crow flies. In the map, this corresponds to the outside of the fourth buffer.

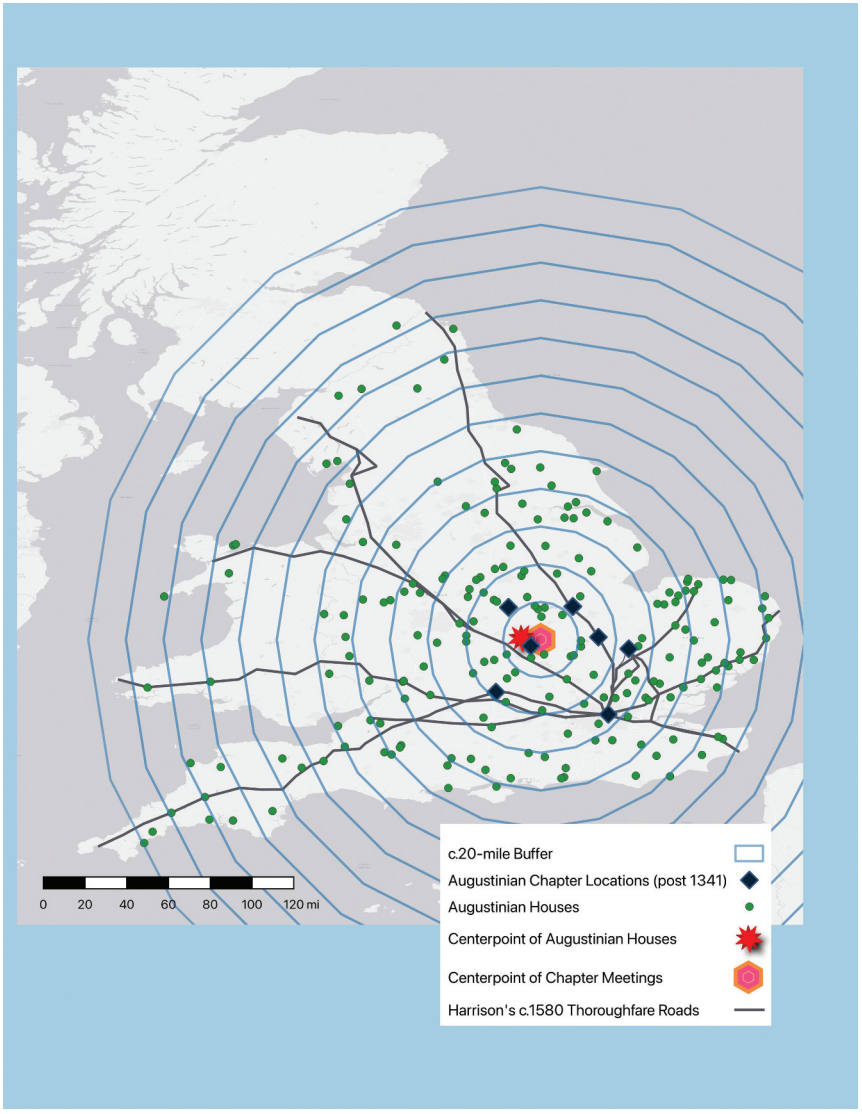
[64]The list of houses was derived mainly from David Knowles and R. Neville Hadcock, *Medieval Religious Houses, England and Wales*, revised edition (New York: St Martin's Press, 1972). Houses that went out of existence might still be represented in our maps. Additional verification of houses relied sometimes on the Victoria County Histories of England; and David M. Smith and Vera C.M. London, eds., *The Heads of Religious Houses, England and Wales, vol. II, 1216–1377* (Cambridge: Cambridge University Press, 2001). For chapter locations, see H.E. Salter, *Chapters of Augustinian Canons* (Oxford: Oxford University Press, 1922).




**Map 6.** Augustinian houses and their centerpoint.

Consistent with the idea that 20 miles a day was a good travel speed, four days each way was the expectation. Still, four days is significant travel, and in the galaxy of houses they had created, many Augustinians had no choice but to travel even further. The furthest quartile would all be traveling over a hundred miles, and the furthest canons would be coming from over 200 miles.

At the risk of obscuring points, Map 7 also includes a schematic of main roads. These are based on William Harrison's list of "thoroughfares," produced during the reign of Elizabeth I (1558–1603). Aside from suggesting how few Augustinian houses were on the main national roads, it also shows




**Map 7.** Augustinian triennial meetings and travel.

how the canons were likely to funnel themselves together as they traveled, potentially meeting each other on the road and allowing for planning before the meeting. Perhaps more strikingly, however, it shows that all but one of the seven houses used for the triennial meetings were located on or very close to these main thoroughfares.

Finding centrally located meeting places was important to prevent absenteeism. For example, mandatory attendance at general chapter meetings led another order, the Cistercians, to define valid and invalid excuses for abbots to miss the general chapter meetings, reasons such as advanced age or illness. Required attendance at such meetings also focused attention on issues of mobility.[65] Although not every order proceeded in the same way, as some already had an ethos of travel, the tri-annual chapter meetings created new travel imperatives, which changed practices or procedures in monastic houses. The spatial dimension helps us to understand such changes.

Whether looking at Spain or England, our maps suggest that monasteries were not places of isolation and stability. Monasteries involved different types of mobility. Monks either cared for travelers or traveled themselves, whether heading to distant general chapter meetings or to visit local towns and parishes under their jurisdiction. Of course, for some monks, this was too much movement. For example, the constant flow of pilgrims past their monastery led two monks from Santa Maria La Real in Nájera, Spain, to seek papal permission to move to the more tranquil Benedictine monastery in Valvanera in 1419.[66]

Creative visualizations of data on mobility can help us better understand not only patterns of large-scale movements, but also the travels of actual people over the course of their lives. Individual trips are relatively straightforward, but rendering the density and complexity of mobility across months or years poses a greater historiographical and mapping challenge. One way is to use a "Ling Pillar" graph, an illustration developed with former Wesleyan undergraduate Stephanie Ling at the Traveler's Lab. It plots an individual person's travel over time but eliminates the confusion of time lapse or animated models. It does require some education to read. It has two elements, a sort of bar graph and a background map, the latter serving more as a reference than as the sort of precision framework we usually take maps to be. The general information is conveyed by the pattern of points, regardless of the map. These are organized so that time advances as one moves or reads upwards, along the z-axis (with the tilted plain of the map being x and y). Reading right to left or left to right describes geographic location. Despite a great deal of detail, the Ling Pillar's power is of a summary and explorative nature because in a 2-D rendering there is a problem or limitation of ambiguity. This is not necessarily a flaw, but it requires new reading habits, and a recognition of the useful fuzziness that

[65]Amelia Kennedy, "'Do Not Relinquish Your Offspring:' Changing Cistercian Attitudes Toward Older Abbots and Abbatial Retirement in High Medieval Europe," *Radical History Review* 139 (2021): 133–35.
[66]Saturnino Ruiz de Loizaga, *Camino de Santiago: Fuentes Documentales Vaticanas referentes al noroeste Peninsular (siglos xiv-xv)* (Burgos: Rico Adrados, S.L., 2017), 121.

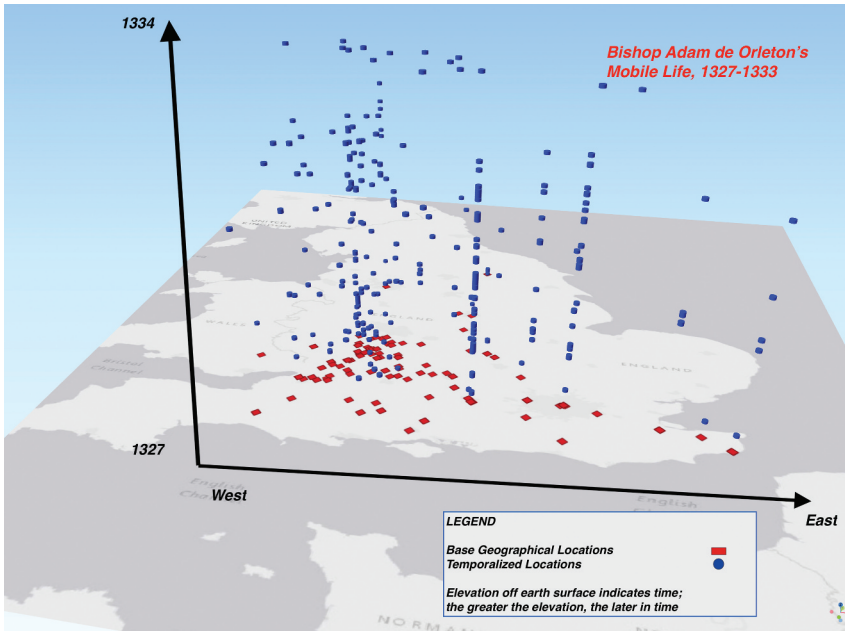
the digital can sometimes offer. For the purposes of reading the following maps, points indicate the presence of an individual – in this case, a bishop – at that time and rough place, and the higher points indicate occurrences later in his episcopate, the lower ones earlier, and a stack or tower indicates repeated presence at a place over many years.

This technique can effectively show changes in the circuit or itinerary of kings, bishops, merchants, or nobles over time, and thereby determine periods of greater or lesser mobility and the character of that mobility. In our wider studies, we noticed various shapes, for instance "skyscraper" or "Christmas tree" patterns, terms we used to summarize different life-mobilities. By contrast, a relatively few distinct towers might suggest a more consistent mobility without so many points of focus, potentially a reduced attachment to particular places or centers of administration or the imperative to more constant travel. Again, while the researcher may have a hunch about how bishops moved or why, the detailed representation of significant data in the illustration opens up new lines of understanding. In Map 8, for instance, which represents the travel of Bishop Adam de Orleton when he was bishop of Worcester for six years, we find several concentrations amidst a good deal of diffusion. The diffusion over some time in the western parts of the map shows that he was indeed present in his diocese and active in its administration, moving from locality to locality.[67] Medieval officeholders have often been suspected, then and now, of absenteeism, and this question might be acute with a very political figure like Adam, who was closely associated with the administration of Queen Isabella in these years. The pillars show real engagement in his diocese.

Nonetheless, the political character of Adam's travel is reflected by how often he was outside his diocese. The three central pillars all show time spent in Berkshire and in the vicinity of London. It was without doubt a peripatetic life, yet structured by habitual trips and familiar bases of operation. The sparse pillars to the east show a path to Canterbury and beyond, including travel to France, which is off the visible map. Apparently, however, in the years 1333–34 a sparser record suggests he was less often in London, probably because Edward III (1327–1377) had established full political control in 1330. At that point, Adam's political influence waned and he became more narrowly a diocesan bishop, as his movements seem to confirm.

The opportunity to compare movements among a group of people, such as bishops, or across kinds of people – say bishops alongside lay aristocrats or merchants – is one of the potential advantages of Ling Pillars. If we consider

[67]For further information on his life, see R. M. Haines, *The Church and Politics in Fourteenth-Century England: The Career of Adam Orleton, c. 1275–1345* (Cambridge: Cambridge University Press, 1978).

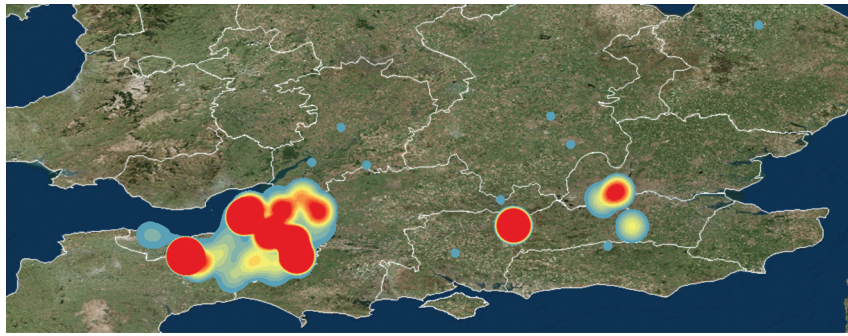



**Map 8.** Ling Pillar visualization of Bishop Adam of Orleton, 1327–34.[68]

Adam of Orleton's case alongside that of Bishop Ralph of Shrewsbury, of the neighboring diocese of Bath & Wells in the same time period, we can start to see the possibilities. Map 10 are Bishop Ralph's Ling Pillars, covering the period of 1329–63.

Side by side, we note a rough similarity between the two cases: there is time spent in London, at locations on the way to London, and then a great density of locations within the diocese. Indeed, the tendency to travel to London will be worth pursuing; it turns out to be a pattern common among many bishops. Notwithstanding a great variety of places of business and residence, episcopal travel was anchored in a smaller group of main locations. Because Ralph of Shrewsbury's pillars capture a much longer period of time, over a quarter century of relatively dense information, his pillars reveal something of his lifecycle at play, including the coming of old age, as trips to London attenuate over time and his final years show one manor as his

[68]This is based on the information in Thomas Scott Holmes, ed., *The Register of Ralph of Shrewsbury, Bishop of Bath and Wells, 1329–1363*, Vol. 2 (London: Somerset Record Society 9 & 10, 1896). The introduction of these volumes gives some biographical information.



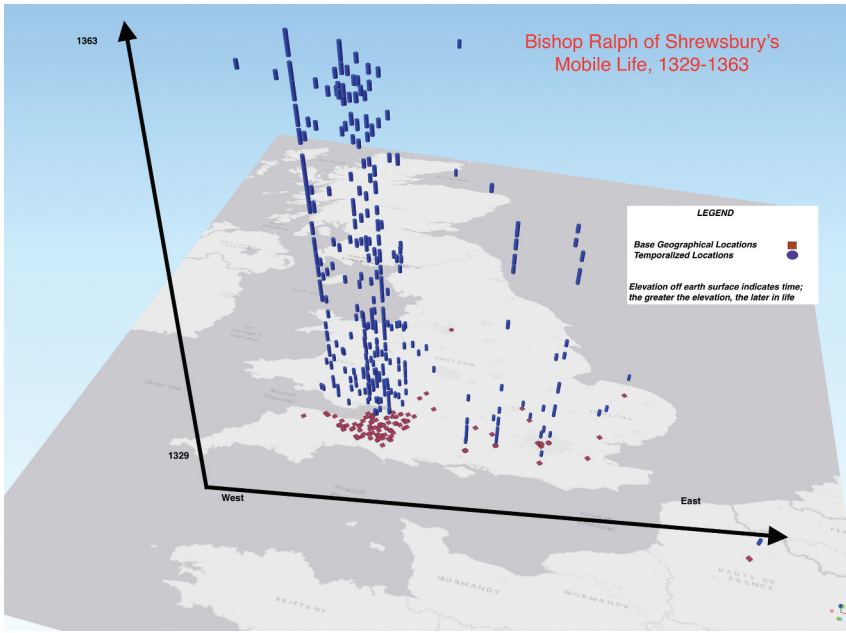
**Map 9.** Heat map of Bishop Shrewsbury of Bath & Wells's mobility, 1329–1359 (created by Stephanie Ling).

mainstay. However, another sort of analysis is suggested by the Ling Pillars, as we try to see just how locations were distributed regardless of time. This is revealed well by Map 9, a heat map of Ralph's activity. Different visualizations provide different perspectives on the world under examination.

This map conveys the areas of Ralph's greatest presence over his episcopate but, on its own, it has no chronological dimension at all. Together Maps 9 and 10 provide a lot of information and food for historical thought.

The location of Augustinian chapter meetings (Maps 6 and 7) and the travel of bishops (Maps 8 and 10) are shown using very different types of maps. One is simple and easy to read; the other (Ling Pillar) requires a little more explanation. The point is that the facts and arguments about mobility can be scrutinized with simple images or more elegant and complex visualizations, depending on intellectual need. Moreover, once the basic spatial data is collected appropriately from archival or printed sources, it is possible through GIS and other programs to generate interesting additional analyses, allowing us to find new patterns. Choosing which to use will often follow from the suggestions that emerge from the previous form of exploratory seeing.

We have also used aggregate data not to look at routes themselves, but to examine underlying methods or patterns of communication. Using the massive collection of letters of the Datini Company, we have created visualizations that assess the relative consistency of travel times along the primary




**Map 10.** Ling Pillar visualization of Bishop Ralph of Shrewsbury, 1329–1363.[69]

spines of communication used by the company.[70] A route with higher consistency provided greater reliability within the communication network, allowing actors clearer expectations around the sending and receiving of business information. As in the *Republic of Letters* project, the primary sources are all individual written communications, covering multiple routes between trading cities, and numbering in the tens of thousands.[71] For one example of the sort of maps this aggregate data can support, we used the standard deviation

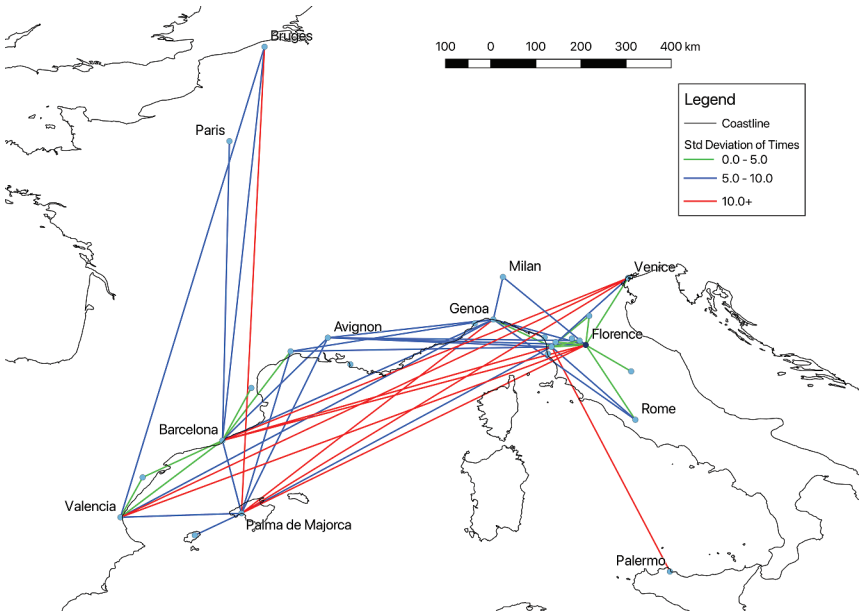
[69]The itinerary originates from R. M. Haines, ed., *Calendar of the Register of Adam de Orleton, Bishop of Worcester, 1327–1333* (London: Worcestershire Historical Society Publications, 10 and Historical Manuscripts Commission, JP 27, 1979).

[70]The entire letter collection is currently digitized through the archive's website. The map and project described here use the metadata connected to each letter to look at the large-scale patterns of frequency or delivery speed. The metadata for the majority of the letters includes the origin and destination, along with the dates of origin and delivery; see: http://datini.archiviodistato.prato.it/carteggi/ (accessed June 18, 2023); Pavel Oleinikov, the assistant director of the Quantitative Analysis Center at Wesleyan University, assisted in preparing the metadata to use with QGIS; Logan Davis, a student at Marlboro College, assisted with the initial analysis, including identifying all the cities involved in the letter communications.

[71]Frederigo Melis, "Intensità e regolarità nella diffusione dell'informazione economica generale nel Mediterraneo e in Occidente alla fine del Medioevo," in *Histoire économique du monde méditerranéen, 1450–1650, Mélanges en l'honneur de Fernand Braudel* (Toulouse: Éditions Privat, 1973), 389–424; this particular work opts for large charts of numbers rather than maps, but the intent is clearly spatial.

(a measurement of variability within a dataset) to measure travel speed consistency along particular routes. Lower standard deviations mean that the times of all trips cluster closely around one number, while a higher standard deviation indicates greater diversity in the recorded travel times and hence lower consistency. The resulting map demonstrates a higher consistency for land routes, even across quite long distances – the sea routes almost universally have the lowest levels of consistency (red) on the map. Additionally, while short routes are usually more reliable than long ones (not surprising), the map also shows certain hubs with more reliable communication within the system, especially around Barcelona and Valencia; the highest clusters of consistency (green lines, which also turn out to be the regions with the highest aggregate speed of communication) appear around Florence and around Barcelona (see Map 11).[72]

This observation would not have been possible without the analytic ability of computer software and the mapping that draws our attention to particular




**Map 11.** Travel time consistency in the Datini correspondence.

[72]For more on visual analysis of financial networks in the early modern period, see Ana Sofia Ribeiro, *Early Modern Trading Networks in Europe: Cooperation and the Case of Simón Ruiz* (New York: Routledge, 2016); and Amélia Polonia, Sara Pinto, and Ana Ribeiro, "Trade Networks in the First Global Age: The Case Study of Simón Ruiz Company: Visualization Methods and Spatial Projections," in Ana Crespo Solana, ed., *Spatio-Temporal Narratives: Historical GIS and the Study of Global Trading Networks (1500–1800)* (Cambridge: Cambridge Scholars Publishing, 2014).

geographic features of the dataset. There are simply too many data points to process manually. The analysis provided by this map supports other work that shows land routes and runners provided high speed and consistency, despite an older narrative that sea transport was always preferable because it was more cost effective.[73] In fact, land-based communications were more effective – both faster and more consistent – than the sea. Plus, the map illustrates the well-developed communication networks in both Italy and the Crown of Aragon. Late medieval narratives often describe improved communication systems as deriving from the mercantile need for news, which is closely associated with Italian cities and their accompanying *Scarsella* mail service networks – designated courier routes financed by Italian companies that linked important political and economic hubs such as Florence and Avignon.[74] Communication developments in the Crown of Aragon derived from changes in royal administration which filtered down to influence urban and mercantile practice. As this map shows, the availability of quality messengers could then support higher speeds and greater reliability, even for communication within an Italian company operating in the same region.

One of the notable goals of research into mobility is filling in many of the blank spaces, helping us to both highlight what we can do with the data available to us and recognize what our questions could be for future projects. We hope these few examples give readers a sense of the types of new analysis that we have been able to create with mapping techniques and how that has created valuable new knowledge (even if only contingent) about travel in the Middle Ages. Both simple and complex visualizations can help to answer questions about mobility and raise new questions as well. For example, our various illustrations make clear that many people were on the move and that infrastructure (e.g. roads and accommodations) was built to facilitate travel. Even those people who did not travel learned about the world through extensive letter networks (such as the Datini) or through books with geographical references or conversations with those who did travel. Medieval people, even those who traveled little, must have had more ample mental maps of their world than often realized. We also hope that these examples might help to inspire new research and new collaborations, for this is another of the approach's prospective strengths: the collaborative

[73]Peter Hugill, *World Trade since 1431: Geography, Technology, and Capitalism* (Baltimore, MD: Johns Hopkins Press, 1993), 48–51; an analysis of transaction costs in Hamburg by Oliver Volckart showed that not only were ships not cost effective, but the city often preferred individual runners even to horses as the best form of communication; see "The influence of information costs on the integration of financial markets: Northern Europe, 1350–1560," SFB 649 Discussion Paper, No. 2006,049, Humboldt University of Berlin, Collaborative Research Center 649 - Economic Risk, Berlin (2006), 28–29.

[74]Juraj Kittler, "Caught between Business, War and Politics: Late Medieval Roots of the Early Modern European News Networks," *Mediterranean Historical Review* 33, no. 2 (2018): 204–05; Jong Kuk Nam, "The Scarsella between the Mediterranean and the Atlantic in the 1400's," *Mediterranean Review* 9, no. 1 (2016): 53–75; and Don Harreld, *High Germans in the Low Countries: German Merchants and Commerce in Golden Age Antwerp* (Leiden: Brill, 2004), 41, 45–46, and 58.

nature of the Traveler's Lab helps historians who typically work individually to share resources and strategies to forge ahead in this new field.[75] That is, digital projects encourage greater collaboration between scholars and greater participation of students into ongoing research. This enables more students to participate in the creation of new knowledge.

## Conclusion

Maps are an important tool to gain and to spread knowledge. Visualization makes the past come to life for modern students brought up with infographics on their smartphones rather than static maps in printed atlases. But visualizations are also a way for historians to think about difficult problems in productive and collaborative ways. Much has been written in the last decade about the interactions between history (and the humanities more broadly) and new digital tools and methods. John Theibault has noted that historians have always adopted these tools quickly, even if they have been generated through the work of scientists or sociologists.[76] Narrative has served history as a means of conveying patterns observed in individual sources, and ultimately our goal has been to illustrate how visualizations, in general, and maps, in particular, can offer another tool to detect and communicate patterns across the sources from which we reconstruct the past.

Nonetheless, visualizations drawn from even the cleanest data are always constructed, contingent, speculative portrayals. Their role is to aid our historical intuitions and to expand our historical imaginations. Like narratives, visualizations present patterns to be read and interpreted: understanding them is a matter of discussion, analysis, and debate. This is a good thing, and it is also something that we need to incorporate into our historical practice. New systems of pattern recognition require us not simply to bend the software to our data (or worse, our data to the software), but to learn new ways of reading. This involves taking methods not just from existing technologies (like GIS), but moving beyond prepackaged visualizations to create new experiments in story-telling and analysis. Visualization, like the writing of history, is experimental, and its best use is in generating numerous options that, even in the act of making them, guide us to new questions or areas of research. Analytical visualizations can open up entirely new approaches to

[75]Traveler's Lab at Wesleyan University http://travelerslab.research.wesleyan.edu (accessed May 6, 2023).
[76]Theibault, "Visualizations and Historical Arguments," 174–75.

the past through big data correlations, as well as specific new connections that we might not have noticed otherwise.[77] They can capture broad and narrow patterns and point the way toward new areas that permit both traditional, focused case studies and experimental, interactive, and temporary publications.

In the maps we have presented here, the images vary in their relationship to the perceived "reality" of a map. Some methods, like heat maps, show the significance of certain features against a basically "real" physical backdrop. The Datini map shows the regional geographic patterns of data that could also be represented on other types of graphs. Other maps, such as the royal itinerary, eschew the actual shapes of a long road by using only straight lines to show the frequency of general routes. We know these routes correspond with newly built roads even if we do not know the roads' actual course. We might play with the concept of space by completely abstracting geography, as in the Tree Map of the *Chronicle* of Theophanes, or the Ling pillars, which demonstrated the utility of a focused abstraction of the vertical dimension – obviously divorced from any real *travel* – to represent real *patterns of movement* during a human life. As noted in the introduction, more abstract maps can be more difficult to read, but they also help us avoid the trap of assuming that the patterns we observe are natural or inherent, rather than constructed interpretations.

The visualizations we presented made it possible to achieve pattern recognition with very different scopes of information as well: our datasets varied greatly in size. For example, the Datini dataset consists of over 100,000 items, whereas the Camino monastery dataset has only 58 data points. Both large and small datasets contain patterns, and one does not need "big data" to play with digital technology, to find hidden spatial patterns, or to gain new understanding.

The problem of scale is not an inhibition to productive visualization, but an exciting challenge for interpretation. We must remember that when algorithms find patterns in mobility data (for instance, by generating maps of communication networks), they do so by relying on hundreds and thousands of individual interpretive choices about how to understand the historical documents in question. In this way, visualization increases interpretive opacity by placing another layer between the documents and the audience – whether a reader or a viewer. This challenge should not send us into retreat, but rather inspire us to pursue better practices of documentation: of the project, the sources, and the methods of interpretation (whether visualization or

[77] For more on Big Data, see Viktor Mayer-Schönberg and Kenneth Cukier, *Big Data: A Revolution That Will Transform How We Live, Work, and Think* (Boston: Mariner Books, 2013), 35–36, 45–48, and 191.

narrative). Traditional historical arguments are built on foundations no less wobbly, and so we close in hopes that the examples here not only show the promise of spatial visualization for research and teaching, but point the way toward making such interpretative work more apparent and worthy of publication in its own right.

Finally, incorporating a geographical perspective into our work allows us to probe more deeply the human experience and thereby connect events and places in more meaningful ways. The aggregation of data makes possible the visualization of human activities, events, and processes in a common space and geography, and it allows for the examination of complex human systems that connected distinct places in ways written documentation alone cannot. We hope that the examples here of the growing "mainstream" historical use of a wide range of digital methods to visualize historical data inspire more. Our key point here is that undertaking such research does not have to be complicated. There are a great variety of uses of digital mapping, network analysis, and graphing. But what needs doing most is to overcome fear and hesitation by accepting that through minimal efforts we can fit visualization into the normal run of our shared historical work. The structuring of source materials as data in spreadsheets is just another way of recasting the notes we all already take, and this simple structure is all that is needed to access dozens of visualization and mapping tools. The possibilities offered by simple digital technologies allow us to rethink what we know and how we know it. We are confident that the visualizations we have offered will appear comprehensible if not familiar, and they were produced from historical data as rooted in the sources as any other historical work. When combined with an open-minded approach to analysis and interpretation, our shared work will not only allow us to postulate new historical facts, but enable new interpretative frameworks for the very nature of mobility in the past.

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No potential conflict of interest was reported by the author(s).

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