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Fictional Landscapes and Fuzzy Maps

When looking at the digital modeling and analysis techniques available to today's historians, there seems to be disconnect between the realities of medieval data and the expressive capabilities of those tools. Today, I am not going to talk about ways to clean up this data, or about the occasionally problematic ways we handle and map archaeological evidence. I am going to discuss methods through which we can work with uncertain or contradictory evidence found in specifically written sources. How should we visualize the data we pull from these sources? What concerns should we have about pulling data from sources we are trained to heavily criticize and distrust? How do we demonstrate our own uncertainty about this source data in the resulting visual argument or augmentation of our argument?

By examining techniques from outside our field and adapting these methods to our sources and our methods of historical analysis, we can find ways to create visualizations of medieval sources that demonstrate our understanding of the problematic and incomplete nature of these texts, while making a case for the validity of these visual arguments as forms of historical analysis. In the following sections, I will discuss how utilizing methodologies currently being explored by literary scholars and geographers can change the way historians look at maps. In particular, these sections will look at how understanding fictional landscapes and using fuzzy cognitive mapping theories can help historians account for the authorial bias and inherent uncertainty found in our sources. These are not concrete solutions to every problem, but are intended to provide historians with ideas about how to reconsider mapping complex data.

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Medieval place data is inherently ambiguous and therefore difficult to enter into GIS software or tools like Google Maps, leaving those of us who wish to analyze space and place with little recourse but to force this information to fit into modern conceptions of spatial representation. This is especially true when working with textual sources; while archaeological evidence and extant structures can provide the necessary datum points to create point-based maps, written sources are less clear about specific locations. My own project involves working with sources for the Justinianic plague that vary in language, method, and motivation, making it difficult to manage any geographic information I can gather. In a field where clean census or satellite data is not guaranteed, how can medieval historians deal with problematic location information, coming from problematic source material, in ways that embrace the ambiguity of the data?

While it is possible to make an easy representative map by targeting specific (modern) geographic points, we know that maps produced using this methodology may result in misleading depictions of ancient and medieval areas of influence, movement, or settlement. Conflicting sources and ever-changing notions of borders and areas of influence make life difficult for pre-modern historians interested in mapping. There are other options; recent advances in GIS technology and the adaptation of the methods of cognitive science for dealing with the vagueness of human-produced data have led to the development of geographic fuzzy set data and algorithms that make it possible to move beyond precise data points, and include regions defined by a number of different layers of data points, lines, or polygons. These analytical methods allow for the visual representation and layered construction of vague location data. Spatial analysis designed to represent ambiguity provides medieval historians with a way to model and analyze the complex relationships between space and place, humans and their environment, and textual and material evidence.

Literary scholars have embraced a kind of comparative perspective-based mapping technique to deal with authorial voice and the intentional manipulation of literary geographies. In publications related to the *Literary Atlas of Europe*, Anne-Kathrin Reuschel, Barbara Piatti, and Lorenz Hurni discuss methods that might be used to map literary data that is vague or even imaginary, using GIS and other digital mapping tools. More importantly for this project, they argue that:

A certain geospace, used as textual space within different fictions, is never the same: Prague through the eyes of Paul Leppin (German Prague writer) is another Prague than through the eyes of Alois Jirásek (Czech Prague writer), even though both were living at the same time and using imported places by the majority. Their descriptions of Prague differ to such an extent that one might think they were writing about different towns.[[1]](#footnote-2)

In literary geographies, mapping cannot be limited to finding and matching place to real world location; authorial perspective must be a necessary element in creating maps from literature. For the authors considered in my project it is imperative that we understand how they wanted to present the world of the Justinianic plague to their readers. For Procopius, centered in Constantinople, the plague's influence on the Byzantine empire formed the core of his description. Just as the Pragues of Leppin and Jirásek differed, so too did the landscape of a plague-ridden Mediterranean to Evagrius and Procopius. In essence, the locations described in Justinianic plague texts have been fictionalized to fit the purposes of their descriptors. In dealing with fictionalized locations, we must deal with the personalities of their creators and map not the *real* geography of the plague, but the fictionalized reality of its authors.

Additionally, the version of the world that appears in travel narratives presents an interesting challenge. John of Ephesus's travel narrative documenting evidence of the plague between Alexandria and Constantinople is replete with anecdotal evidence, relative location evidence, and interactions between the author and those affected by the plague. In their *Deep Mapping of Brazil* project report, Sandes and Owens analyze travel narratives and argue for the creation of maps based on authorial perspective and connections between the author and the people, events, and environs the author encounters.[[2]](#footnote-3) Using known geographic waypoints, and connecting them with the events and stories related in the narrative, this kind of deep mapping technique does not depend on strict geographical data or statistics, but on a kind of created relational database of the author's environment.

As medievalists, we can analyze the authors of our sources similarly. While we cannot necessarily put together a side-by-side comparison of Procopius's Constantinople and the “real” geographic world of the Byzantine empire in the sixth century, we can use the geographic name-dropping and descriptive evidence in saints' lives, travelogues, church histories, missionary reports, and political histories to understand and visualize the way that our authors understood their environment, or how they wanted their readers to see the world. Layering literary perspective maps for these authors gives us a visual representation of how these authors created their own plague geographies. Moreover, modern epidemiologists are incredibly dependent on witness testimony and even anecdotal evidence to track the movement of a disease. In a sense, these sources serve the same purpose as oral histories of earlier plagues do for modern disease investigators. Putting these stories together visually can, perhaps, give some sense of the scale of the disease in popular memory, and serve as a barometer for the global impact of a plague pandemic. This rationale for mapping historical epidemics is not new, but I would argue that the important thing to remember is that the visualizations created from these sources, however centered in theory or developed using the most advanced mapping software, should still be approached as critically as we have been taught to approach the sources on which they are based.

These literary mapping techniques reflect a movement within the field of geography toward integrating vagueness in geographic data, and the development of methods for dealing with fuzzy statistics and messy ontologies. For those of us interested in creating historical maps that can serve as visual arguments or analytical tools, an understanding of how geographic scientists have been using visualization tools to develop geographic arguments seems essential. So as we attempt to wrangle problematic source information into useful and useable maps, it is only logical to see how geographers handle human source data and issues of vagueness or uncertainty in their own data collection process. In this section, I will briefly trace the development of fuzzy cognitive mapping from an initial philosophical paradox, to the implementation of fuzzy set theory, and finally to the development of an algorithm that can be used to visualize uncertainty.

Geographers dealing with human data have turned to philosophy and to the cognitive sciences to address uncertainty and the ontological roadblocks thrown by the development of a global geographic community; terms used in one location to describe hills, mountains, swamps, and forests, posed problems when combined with local definitions of the same. Geographical concepts like ‘mountain,' ‘hill,' and ‘village’ provide a challenge to geographers who need to define borders between terms — and between regions.[[3]](#footnote-4)

In an effort to determine a terminological system for these boundary spaces, Peter Fisher turned to both philosophy and mathematics. Boolean models cannot describe most geographic concepts — features and delineations are rarely defined as either one thing or another, and definitions change according to the region of origin and experiences of the geographers involved in describing these concepts. Fisher, therefore, seeks a “formal recognition of vagueness in geographical phenomena.”[[4]](#footnote-5) In doing so, he suggests the use of the Sorities Paradox, multi-valent logic, and fuzzy sets. The Sorities Paradox dates back to the ancient Greeks, and should be familiar to most historians, if not in name, then in concept. The paradox asks the question ‘what is a heap?’:

Is one grain of sand a heap of sand? The answer to this simple question is clearly NO.

If a second grain is added to the first, is there a heap? Again the answer is NO.

If a third grain is added, is there a heap? For a third time the answer is NO.

Therefore, if there are n grains, but no heap, then adding one grain to make n + 1 grains will not make a heap. The paradox, of course, is that at some point there will be a heap, and that at some point past that, there will be more than a heap and the argument can reverse.[[5]](#footnote-6) The fuzzy area is the space between grain and heap. Fisher argues that, because the Sorities Paradox can be used to test for vagueness, geographers should apply it to geographic concepts to determine whether or not they fall into this category.

What fuzzy set theory, when combined with cognitive analysis, can do is model vagueness, or potentialities in complex systems.[[6]](#footnote-7) To some extent historians use fuzzy set theory in determining eras or periods of time. We assign some seemingly random set of years the term ‘early modern’ or ‘late medieval’ in terms of where they exist on a spectrum of modern vs. not modern or medieval vs. not medieval. For geographers, and for historians interested in the application of GIS and geographic concepts to historical analysis, the boundaries between geographic concepts and the efforts to solve ontological disagreements[[7]](#footnote-8) are an important part of dealing with the fuzziness of human interpretation of geographic features.

Fuzzy datasets involve evaluating the 'membership' of something between one category and another, and then mapping the level of membership.[[8]](#footnote-9) These mathematical or conceptual sets can be used to talk about uncertain human data; borders of cities can be determined by what locations are clearly “IN” or “OUT”, and by understanding the levels of “in-ness” or “outness” applied to a specific area.[[9]](#footnote-10) In discussing Procopius or Evagrius' notion of the borders of empire, for instance, levels of membership in the influence-area of the empire can be assigned and presented based on our reading of how locations are depicted in the source, and on what we know about these locations from other sources. Assigning membership grades to data allows GIS to be used to examine vague or uncertain information, or add levels of influence to different sources. While we may not be interested in the details of the algorithms generated by this research to create these fuzzy sets and relationship/membership ratings in creating historical maps, we should recognize the value of this theoretical approach in addressing complexity and uncertainty in our historical analyses. The visualization of a membership set allows us to show these gray areas in our data. For historians augmenting or constructing an argument using geographic analysis, the revelation of this fuzziness and uncertainty is essential.

In order to put lines on our maps, in order to construct deep (context) maps of historic events like the Justinianic plague, historians need to be familiar with and involved in the current debates in geography. The math involved is less important than the theory, but the math helps generate the models we need to use to convey uncertainty in historical analysis. Just like modern geographers cannot remove maps and the varying geographic ontologies from their context, historians interested in utilizing tools like GIS or other spatial technologies should understand how boundaries are determined, how tags and other forms of metadata are created, and perhaps offer our own methodologies to a field that is moving beyond binary logic and into the fuzzy space where we do our work.

So how should historians handle vague map data? How might medieval historians, in particular, use maps to better understand our limited textual sources? In his discussion of medieval plague maps, David Mengel argues that maps, unlike scholarly texts, “struggle to represent ambiguity, uncertainty, and provisional conclusions.”[[10]](#footnote-11) He goes on to suggest that while the medium of maps is problematic, the nature of the audience is equally responsible for the misuse of historical maps; he claims, perhaps rightly, that readers often tend to treat maps like accurate depictions of reality. Mengel's solution to both of these problems, that “not everything should be mapped” strikes me as a poor substitute for a more considered analysis of maps and their uses as both primary sources and as analytical tools.[[11]](#footnote-12)

By incorporating the work of literary scholars and geographers, however, we can create maps that *can* show ambiguity, and are able to handle the uncertainty inherent in any kind of historical study. Points on maps created with GIS and JavaScript libraries can contain their own descriptions, source information, and cautionary information. Additionally, by borrowing and adapting the tools of philosophers, geographers, and cognitive scientists, historians mapping even vague relational or locational data can represent fuzziness and conflicting information using layers, variations on heat maps, and membership analysis using fuzzy sets. These maps will not be perfect representations of reality, but then, neither are our textual sources. Expecting maps created from flawed data to somehow solve the associated vagueness or problematic nature of the information goes against everything we are taught as young historians about using primary source data. We can use mapping, however, to combine data from different sources and to integrate archaeological and environmental data, resulting in a visualization that is as representative as possible of what we think we know about a particular series of events at that moment in time.

As historians of Late Antiquity and the Medieval period, we are trained to read our sources like eye-witness statements in a trial. Wrapped in opinion and hearsay, and often motivated by moral or storytelling concerns, our written and visual sources are particularly difficult to turn into functional or useful data. Numbers are often assumed to be exaggerated or poorly translated, so how can we truly know the casualty rate of the Justinianic plague, or the true number of troops sent to North Africa? How do we read Procopius as a source in both the *Wars* and the *Secret History*? Searching for objective “truth” in historical sources is not something we are trained to do, nor should it be. A fuzzy cognitive map, or an accompanying visualization, can show how this data fits into a fuzzy set of possible solutions to a complex historical problem. When I look at the use of plague around the Mediterranean after the Justinianic plague, I can show how different uses of plague words relate to concrete instances of a plague outbreak.

Just as geographers must account for ontological and cultural differences in the creation of modern maps, and epidemiologists readily integrate anecdotal evidence and oral histories into complex maps of environmental systems and routes of movement to visualize epidemics, historians should account for changing technologies and theories when we seek to create our own maps.The authors we analyze certainly considered the landscapes they wrote about as malleable as the stories they told, so our visualizations of their data must account for this fictionalizing of space and place. Using and adapting tools and methods developed in other fields, we can create maps that are arguments for one version of an event, presented in a visual language that uses a common geographical frame of reference to help the reader place that argument in context.

1. Anne-Kathrin Reuschel, Barbara Piatti, and Lorenz Hurni, “Modelling Uncertain Geodata for the Literary Atlas of Europe,” in Understanding Different Geographies, ed. Karel Kriz, William Cartwright, and Michaela Kinberger, Lecture Notes in Geoinformation and Cartography (Springer Berlin Heidelberg, 2013), 140, http://link.springer.com/chapter/10.1007/978-3-642-29770-0\_11. [↑](#footnote-ref-2)
2. Sandes, Anderson C. and J.B. Owens. “A Globally Oriented Deep Mapping of Brazil,” http://www.academia.edu/205957/A\_Globally\_Oriented\_Deep\_Mapping\_of\_Brazil. [↑](#footnote-ref-3)
3. Peter Fisher and Jo Wood, “What Is a Mountain? Or The Englishman Who Went up a Boolean Geographical Concept but Realised It Was Fuzzy,” *Geography* 83, no. 3 (July 1, 1998): 247–256. [↑](#footnote-ref-4)
4. Peter Fisher, “Sorites Paradox and Vague Geographies,” *Fuzzy Sets and Systems* 113, no. 1 (July 1, 2000): 7. [↑](#footnote-ref-5)
5. Ibid., 8. [↑](#footnote-ref-6)
6. João Paulo Carvalho, “Rule Based Fuzzy Cognitive Maps in Humanities, Social Sciences and Economics,” in Rudolf Seising and Veronica Sanz González, Soft Computing in Humanities and Social Sciences (Springer Science & Business Media, 2011), 287. Carvalho gives a brief but good description of how fuzzy cognitive mapping allows for the representation of complex systems and the modeling of events and their influence on the complex system. These graphs are not maps, but illustrate the capability of fuzzy visualizations to handle non-linear dynamic systems. [↑](#footnote-ref-7)
7. For a discussion of how tagging and ontologies develop organically and should be incorporated into classification systems, see: Marieke Guy and Emma Tonkin, “Folksonomies,” *D-Lib Magazine* 12, no. 1 (January 2006), http://www.dlib.org/dlib/january06/guy/01guy.html; N. Guarino, “Formal Ontology, Conceptual Analysis and Knowledge Representation,” *International Journal of Human Computer Studies* 43, no. 5 (1995): 625–640; T. R. Gruber and Stanford University Knowledge Systems Laboratory, *Ontolingua: A Mechanism to Support Portable Ontologies* (Stanford University, Knowledge Systems Laboratory, 1992). Guarino ad Gruber both support enforcing ontological systems of classification in order to support interoperability and portability between GIS systems. [↑](#footnote-ref-8)
8. Guesgen, Hans Warner. “Fuzzy Reasoning about Geographic Regions.” in Frederick E. Petry, Vincent B. Robinson, and Maria A. Cobb, Fuzzy Modeling with Spatial Information for Geographic Problems (Springer Science & Business Media, 2006), 6. [↑](#footnote-ref-9)
9. Z.-Q. Liu, “Fuzzy Cognitive Maps in GIS Data Analysis,” Soft Computing 7, no. 6 (May 1, 2003): 394–401, doi:10.1007/s00500-002-0228-0. [↑](#footnote-ref-10)
10. D.C. Mengel, “A Plague on Bohemia? Mapping the Black Death,” *Past & Present* 211, no. 1 (2011): 8. [↑](#footnote-ref-11)
11. Ibid., 33–34. [↑](#footnote-ref-12)