This report surveys a successful attempt to build a HGIS (historical geographic information system) of liturgical processional routes in the city of Constantinople (modern day Istanbul) during the 9th and 10th centuries. Data about the routes was gathered from the *Typikon of the Great Church*, a medieval book describing the liturgical ceremonies of the Hagia Sophia, the largest and most important church in Constantinople during the Byzantine era. Information about the different churches mentioned in the *Typikon* was gathered from a variety of sources, most notably from Raymond Janin’s multivolume series on the subject.

Major problems during the construction of the HGIS were finding accurate information on churches that no longer exist, constructing a map of an area which is dramatically different today topologically and the lack of English language sources. Despite these problems, the resulting HGIS allows for a clearer view of how processional routes moved across the city.

**Headings:**

- Digital Humanities
- Historical geographic information systems
- Byzantine Empire -- Study and teaching
- Processions, Religious
- Humanities -- data processing
TRACING FOOTSTEPS: A HGIS PROJECT MAPPING OUT LITURGICAL PROCESSIONS IN 9th AND 10th CENTURY CONSTANTINOPLE

by

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Approved by:

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Ryan Shaw
INTRODUCTION

The rise of digital humanities and HGIS (historical geographic information systems) in particular has allowed people to approach the field of history in a whole new way. One example of this is visualizing what had been before locked away in texts, allowing for greater access to and understanding of events such, liturgical processions in Constantinople.\(^1\) Constantinople was the wealthiest and largest city in Europe in Late Antiquity and much of the Medieval period and the capital city of the Eastern Roman Empire and Byzantine Empire. Building on the work done by Albrecht Berger, who illustrated a liturgical procession from the Hagia Sophia to the Church of Holy Apostles,\(^2\) this project attempted to construct an HGIS system that would trace twenty liturgical processional routes\(^3\) on top of a map of Constantinople. The successfully created system allows users a better view of how processional routes moved across the city, how processions tended to use the major roads in the city and a general idea of the length of each procession.\(^4\) Because of the topographical differences between Constantinople and modern-day Istanbul, it is impossible to create a geographically exact map of Constantinople, meaning that this project in its current form only shows a representation of where the routes went in the city.

\(^1\) Modern-day Istanbul


\(^3\) Known as *Lite* or *Lita* in the Byzantine Era.

\(^4\) It is important to note however, that the locations of many of these churches are not exact, due to the shifting topography of the city and the constant construction within modern-day Istanbul. This prevents any exact measurement of route length.
DEFINITION OF PROCESSIONS

One of the most exciting, public and common sights in the Byzantine Empire was the liturgical procession. Its importance to the Byzantine people is obvious from the plethora of written records describing its function, form and popularity among all social classes in the empire. Before discussing what a liturgical procession was in the Byzantine society, it is important to define what a procession is, how it relates to other forms of public performance and what the general characteristics of processions are. For the purposes of this paper I am using the definition suggested by Kirshenblatt-Gimblett and McNamara, “a performance in motion through space”5 Further, I am following Richard Schechner’s argument that processions could (and should) be seen as a theatrical production, a form of theater that is located within the natural space of the city, the village or any space not directly designated or designed for the purposes of performances (such as theaters, arenas etc.). Schechner thus suggests that, “In a procession – which is a kind of pilgrimage – the event moves along a prescribed path, spectators gather along the route, and at appointed places the procession halts and performances are played.”6 Such movement is an essential aspect of the ritual and forms one part of its symbolic importance, along with costumes, music, choreography and props.

Importantly, processions always have a goal at the end of the performance: “the funeral to the grave, the political march to the speakers’ stand, the circus parade to the big

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top, the pilgrimage to the shrine;” and the end is always rehearsed, practiced and visualized before the performance even begins. To this end, some processions are highly formalized with clearly defined routes punctuated by special locations or units. One notable example of this is the Via Dolorosa, the linear reconstruction of the suffering and death of Christ as marked by the Stations of the Cross. These linear processions create a shared goal of a community on a pilgrimage. However not all processions have a clearly defined beginning or end. Some may be circular in nature. As Lara argues, “circular processions were often directed toward some central object of veneration that objectified, and often reified, the values of the community.” An example could be a procession around a church or other holy ground in order to provide protection for the entire community. Regardless of their goal, all processions create a community out of separate individuals. Victor Turner argued that this community was momentary in nature and unstructured compared to the more socially conventional community. This sense of a common goal and collective emotional ties transcends social barriers and creates a momentary feeling of shared equality.

Catherine Bell in her work, *Ritual: Perspectives and Dimensions* lists six general characteristics of processions. The first is *formality*. Processions are often characterized by more restricted codes of communication, more so than “normal” behavior. This includes, attire, gestures, stylized speech and specific, formal locations. Bell further argues that in order for the event to be formal, there needs to be at least two groups of

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7 Ibid., 160.
people, something which “forces the speaker and the audience into roles that are more difficult to disrupt.”\textsuperscript{12} Another aspect of the procession is its appeal towards \textit{tradition}. The rules that guide processions are often formed on past practice. Examples of this include the careful following of historically prescribed liturgy, appeals to past authorities and the appeal towards past practices, real or fictitious. These actions allow the procession to create both a sense of symbolic continuity with the audience and a ritual coherence.\textsuperscript{13} The third characteristic is \textit{disciplined invariance}. In order to achieve the desired results, prevent audience distraction and to connect to the audience through shared experience, the procession must not stray from the rules that govern it. Repetition of actions and discipline are emphasized and practiced by the participants in order to succeed. As already mentioned, processions must be \textit{rule governed}. Bell notes that, these rules are generally perceived as “formulated norms imposed on the chaos of human action and interaction.”\textsuperscript{14} Processions are important to a community because of their \textit{sacral symbolism}. The performance allows the audience to connect to a sacred space that is outside of an individual’s normal existence. Not only is this sacred space outside of normal life, but it is often far greater than the individual or community. In order to do this, the procession must employ symbolic phrases and actions, in a manner distinct from everyday life. Finally processions are defined by their \textit{performative} nature. The actors deliberately engage with the audience via symbolic actions and behaviors in order to bombard them with multisensory experiences. The performative nature of the procession allows the ritual to connect with the audience. It is designed to compete with the existing environment and to become the dominant element in order to prevent distraction. The

\begin{itemize}
  \item \textsuperscript{12} Ibid., 140.
  \item \textsuperscript{13} Moore, \textit{Cultural Landscapes}, 130.
  \item \textsuperscript{14} Bell, \textit{Ritual}, 155.
\end{itemize}
symbolic aspects of the procession are presented in a way that is comprehensible to the spectators. Comprehension is further increased due to the repetition of the event. Finally many of these performances take place in spaces that were not officially designed for performances such as theaters which makes them stand out visually.

One final aspect of processions is their reflection of the society that created them. According to Don Handelman in his book, *Models and Mirrors: Towards an Anthropology of Public Events*, the forms of such events, regardless of their meanings or significance, are linked to the social orders of the societies. This is because processions, as a public event, are intrinsically connected to the social order. Processions draw on the resources of social groups, such as families, guilds and churches. As Moore notes, “the processions organized by different social groups reflect variables such as the cost of regalia and items associated with display, the permanence and prominence of the place of display, the uniqueness or ubiquity of the ceremony, and so on.” By the same token, processions emphasize social difference. For example, icons are carried by members of volunteer associations or priests, banners are carried by special military units, etc. Thus, the procession involves and distinguishes diverse social groups. The majority of these points may be illustrated from Byzantine sources. In short, the Byzantine procession was a public performance that allowed a demonstration of faith from both actor and audience, creating a sense of community and belonging in a multisensory environment.

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17 Ibid.
LITURGICAL PROCESSIONS IN BYZANTINE SOCIETY

The most popular terms for Byzantine processions were *litaneuin, litaneia* and *lite*. The verb *litaneuin* and its related noun *litaneia* originally meant to pray, entreat or supplicate in Classical Greek.¹⁸ Neither word is found in the Septuagint, but it is used in early Christian writings with the same meaning as the Classical Greek.¹⁹ According to Baldovin, however, the term came over time to mean supplication made during a procession as seen in the seventh century *Chronicon Paschale* which describes an emergency service during the earthquake of 447; “…and they fled outside the city. All the people were processing with supplications [*litaneuin*] both night and day.”²⁰ In addition, *litaneuin* and *litaneia* also began to mean an outdoor procession that was not held in a church.²¹

Related to *litaneuin* and *litaneia*, the noun *lite* was used to designate a procession in both the *typikon* of the Great Church and the *De Ceremoniis.*²² Like the previous terms, it meant prayer and entreaty in Classical times but came to refer to supplication in Christian writings. An example of this can be found in Sozomen’s description of the Antiochene procession during the Affair of the Statues in 387:

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¹⁸ Liddell and Scott, Greek-English Lexicon sv.
²¹ For an example of *litaneuin* being used to describe an outdoor procession see Mateos, *Le Typicon de la Grande Eglise*. (Orientalia Christiana Analecta: 1962-1963), November 6. 9.
²² Baldovin, *The Urban Character*, 207.
In this time, on account of the necessities of war, it seemed best to the officials whose concern it was, to impose more than the customary taxes; for this reason the populace of Antioch in Syria revolted; the statues of the emperor and empress were thrown down and dragged by ropes through the city, and, as is usual on such occasions, the enraged multitude uttered every insulting epithet that passion could suggest. The emperor determined to avenge this insult by the death of many of the citizens of Antioch; the people were struck dumb at the mere announcement; the rage of the citizens had subsided, and had given place to repentance; and, as if already subjected to the threatened punishment, they abandoned themselves to groans and tears, and supplicated [litas] God to turn away the anger of the emperor, and made use of some threnodic hymns for their litanies.  

The *lite* was a liturgical procession comprised of clergy and laity, who would proceed to a specific church or “station”, often for the celebration of a feast. Structurally, the *lite* could precede the Eucharistic service for that particular feast day or it could be a separate service that would be totally independent from the communion liturgy.  

In Jerusalem, these processions were limited to Holy Week but in Constantinople, they occurred throughout the year and were connected with saints’ days and the anniversaries of major events in the church. For example, on 7 October, there was a procession in memorial of a devastating earthquake that hit Constantinople in 533. In the *Typikon* of the Great Church, there are sixty-eight festivals in which the *lite* was a necessary ritual, with the emperor participating in seventeen of them and the patriarch participating in thirty-two of them.  

According to Robert Taft, *litai* “served to combat heresy or plead for some special favor: the remission of sins, cessation of an earthquake, the lifting of a siege, a miracle, or to commemorate the original *lite* on the day when these favor were granted.”

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24 Ibid.
27 Taft, *Lite*.
examples of the commemorative nature of the *lite* are located in the Menologion of Basil II, written in ca. 1000. For 26 January, the document calls for a commemoration of an earthquake that occurred during the fifth century. Similarly, on 26 October, there is a commemoration of an eighth-century earthquake. In both instances, there is a miniature accompanying the reading that depicts a procession with the patriarch and the emperor standing in the center, surrounded by participants carrying candles.  

Due to its nature and the type of participation involved, the *lite* was thus not just a religious ritual, but also became extremely important in maintaining social cohesion and became a form of civic duty in which the entire community took part in. Evidence for the existence of *lite* can be found as early as the fifth century in the histories of Sozomen and Socrates Scholastikos, when the bishop of Constantinople, John Chrysostom, used imperial funds to organize processions, with participants carrying silver crosses and candles, to compete and protest against the processions led by the Arians in Constantinople and according to Cotsonis by the tenth century, the *lite* “became a technical term designating outdoor, popular liturgical processions that included supplicatory prayers accompanied by psalms and hymns.” Overall then, we can see that liturgical processions were essential in the religious environment of the people living in the Byzantine Empire. Firstly, processions served as a very public outlet for people’s piety and faith. Processions allowed communities to show that they were Christian. As Baldovin aptly summarizes, the processions role; “was to manifest publicly the fact the

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29 Ibid. 15  
Christian faith was the religion which expressed the common-sense faith of the city’s populace. In other words, processions were a means of both prayer and propaganda. “

Secondly, they also permitted the demonstration of correct Christian faith, at least as this appeared correct to the participants, and demonstrated the marking or claiming of territorial possession by one group or another, during the many periods when religious dogma was in dispute. Thirdly, processions narrowed the gap between secular and sacred time via reenactment and mimetic action and finally, they temporarily transformed secular space into sacred space. This allowed the community to band together as Christians in a perfect environment to ask for God’s forgiveness and mercy. Because of its extreme value and popularity, the ritual of the liturgical procession was a constant part of Byzantine urban life, beginning even before the legalization of Christianity by the emperor Constantine in 313, all the way up to the fall of Constantinople in 1453.

33 Ibid.
MOTIVATIONS FOR THIS PROJECT

As mentioned earlier, liturgical processions (lite) were extremely popular and important in Byzantine society. Yet in sharp contrast to the comparative wealth of scholarship on imperial processions, studies on liturgical processions have been far less frequent. The reasons for this include less documentation for liturgical processions than the grander imperial processions. In addition, the focus on imperial processions was connected to the focus on the imperial court and other political topics that dominated Byzantine scholarship for much of the twentieth century. However in the past few decades there has been a shift in Byzantine historiography, with social and cultural frameworks becoming popular and widespread. This shift, together with the translation of more relevant source material, has helped increase the number of studies on liturgical processions, a trend which this project hopes to continue.

Another motivation for this project is to better illustrate the characteristics of a liturgical procession through GIS software. In combination with written descriptions of the processional routes, having a map to see where the procession goes allows for a better understanding of the interaction processions and their participants had with the city.

Finally, many of the materials necessary for this project are still in paper format and not easily accessible to users who do not have access to the libraries that own the materials. This project allows easier access to a summary of these materials.
LITERATURE REVIEW

Studies on Byzantine liturgical processions studies can be broadly characterized as falling into two groups. The first usually focuses on a particular procession or festival. Examples of these include Nathanael Andrade’s work on the processions of John Chrysostom, Bissera Pentcheva’s article on the Hodegetria procession and Angeliki Laiou’s article on the festival of Agathe. The second group instead looks at processions from a liturgical point of view, placing them in a spectrum of religious ritual and actions. This means that, unlike the first group, a wide variety of different processions are studied. However this wide breadth, also limits the amount of focus on each particular procession. Examples of this type of work include John Baldovin’s study of urban liturgical practices and Peter Jeffery’s article on the development and function of liturgical prayer. As we can see, both approaches have their weaknesses with the former being too specific and the latter too broad in analysis.

The use of GIS within the field of late antiquity and byzantine studies is a recent phenomenon but one which has exploded in popularity within the past decade or so with

notable examples including open databases such as *Pleiades*, an open gazetteer and database for ancient places in the Greco-Roman world, and the *Digital Atlas of Roman and Medieval Civilization* (DARMC), a database of georeferenced maps, data layers and other geodatabases. Other projects take a wide angled scope across the Mediterranean and they include Stanford’s ORBIS, which looks at the time and cost of travel across the Mediterranean during Roman and late antiquities and *Mapping the Jewish Communities in the Byzantine Empire*, which aims to map and analyze Jewish life in the Byzantine Empire using GIS. GIS projects that take a narrower look within the confines of the Byzantine Empire include a Cinza Tavenari’s study of the location of caravanserais (roadside inns for travelers) in medieval Syria, Mihailo Popovic’s GIS study of northern Macedonia during medieval times, and finally Andrew Poulter’s study of a Byzantine fortress in modern-day Bulgaria.

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DATA GATHERING

The data gathered for this HGIS project can be roughly divided into two parts. The first concerns the processional routes including the day of the routes, the stops it makes and the reason for the procession. This data was found primarily in the Typikon of the Great Church, a late 9th century, early 10th century book that describes the liturgical rites and ceremonies within the Hagia Sophia. Made up of a calendar with the dates and chronology of services throughout the year, either through a continuous series or by a division between a temporal and sanctoral cycle, it provides an order of service, with directions how ceremonies were to be performed.\(^\text{46}\) This makes the Typikon a valuable source as it shows how often processions occurred in Constantinople in the tenth-century and how they were carried out. The most accessible and most recent version of the Typikon is a French translation done by Father Juan Mateos SJ.\(^\text{47}\) The format of the Typikon was as follows. At its most basic, the entry would contain the date, the reasoning for any special liturgical rite such as a saint’s day, remembrance of an event or a religious holiday. Sometimes then entry would also contain additional instructions for how to perform the rite and any special participants to be included in the procession. This usually included the emperor, the patriarch of the church or any member of the religious or political elite that usually did not participate in the daily liturgical rites in Hagia

\(^{46}\) A typikon is also a foundation document that provides rules and regulations for a monastery.  
Sophia. Here is an example for a short entry for 26 September that contains the minimum amount of information:

> Le trepas du s. apotre Jean, Sa synaxe a lieu santuaire, près de la Grande Eglise. La procession se rend a la synaxe indiquée.48

Here is a longer example that contains information on special participants and instructions on how to perform the rite. An example of this is occurs on 7 October:


From this entry, it can be seen that this procession was not only in memory of the saints Sergius and Bacchus, but also in remembrance of a great earthquake that struck the city in the past. For the liturgical rite, the patriarch would march from Hagia Sophia to the Church of Saint Anastasia where the following prayers were said, “Have pity on us, Lord, Doer of Good Works, and Save us, O Christ our God,” (1) with the Trisagion50 chanted afterword (2) and finally the prayer “Pity us, O Lord, have pity for us.”(3) The procession then went to the Forum of Constantine where the Gloria Patria was sung before returning to the Hagia Sophia.

> Out of the total amount of liturgical instructions contained in the *Typikon*, only the days that contain liturgical processions were chosen, which was sixty-eight, and from

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48 A rough English translation: The death of the Saint John the Apostle. His Synaxis is held in his shrine, near the Great Church (Hagia Sophia). The procession went to the synaxis indicated.


50 The Trisagion was an ancient hymn that went as followed, Ἅγιος ὁ Θεός, Ἅγιος ἰσχυρός, Ἅγιος ὀθάνατος, ἐλέησον ἡμᾶς or in English, Holy God, Holy Mighty, Holy Immortal, have mercy on us.
there twenty were selected on the basis of the churches mentioned, as some churches are so obscure that there is no way to pinpoint their location within the city, not even the neighborhood there were in. Once the twenty processional routes were chosen, an Excel spreadsheet was created that contains the date of the procession, the stops it makes, the page number in the Mateos’ text and then the original French text and a rough English translation. See image I for a screenshot of the processional database in Excel.

Image 1. Processional Database with Information on the Twenty Processional Routes

This step in the data gathering plan took the greatest amount of time overall, primarily due to the translation of the Typikon and selecting an appropriate set of twenty processions that fulfilled all the qualifications mentioned previously.

Having the locations and dates of the processional routes was just half the problem however. Because the location of Constantinople has been built over by the expansion of Istanbul for centuries, only a few churches from the Byzantine era have survived to the present day, including Hagia Sophia, the church at Chora and the Church of Theotokos Pammakaristos, all of which became museums. For the rest of the churches
included in the twenty liturgical processions selected, their locations were gathered from a variety of sources including Raymond Janin’s multivolume series *La Géographie ecclésiastique de l'Empire byzantine*,\(^{51}\) the essays contained in the *Dumbarton Oak Papers*\(^{52}\) and the *Byzantine Churches in Istanbul Project*.\(^{53}\) It is important to note that while it is possible to determine the neighborhood or district these churches were in, it is almost impossible at this point in time to locate them with any further accuracy primarily due to the lack of physical and literary evidence.

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\(^{52}\) Dumbarton Oak Papers 54. (2000).

CHALLENGES AND LIMITATIONS

As mentioned earlier, there were a number of challenges and limitations in designing this HGIS project. The first was the lack of concrete information regarding the church locations mentioned in the Typikon. Some of the churches mentioned in the twenty liturgical processions only have their neighborhood known, with a notable example being the Martyrion of Stephen the Protomartyr which could be anywhere in the Constantinae district. Complicating matters is that often there were multiple churches and monasteries with the same dedication name, often in different neighborhoods making the task of identifying the one mentioned in the Typikon a difficult task. For example there were numerous churches dedicated to Saint Stephen, Saint George and Saints Cosmas and Damian in the city.

A bigger challenge was the topography of the city itself. After the conquest of the city by the Ottomans in 1453 and the renaming and establishment of the city as capital of the Ottoman Empire, it changed dramatically. The old harbors of Constantinople were filled up with silt due to agricultural practices and erosion, new harbors were created, hills were leveled, shorelines were altered and new buildings were built upon old Byzantine ruins. This means that the topography of Constantinople is different than modern-day Istanbul. The major consequence of this is that it is impossible to create a geographically accurate map of what Constantinople was; there is too much geographic difference between then and now to georeference a current map of Istanbul to a map of
Constantinople. Thus the primary goal of this HGIS project, is to show a representation of what these routes would have looked like, not the exact distance each route took or how long it would take to walk from church A to church B. Another challenge in designing this HGIS project was the issue of languages. The vast majority of sources consulted for this project were in French, Greek or German meaning that it took a far greater time than expected gathering the appropriate data as the text had to be translated first and then analyzed to see if it was useful for the project. One final challenge is also related to the sources consulted. Because this type of project has not been done before, with the exception of Albrecht Berger, who did something similar on a far smaller scale and in a non-digital format, these sources are scattered across numerous books, websites and articles, making it difficult to analyze and collect all the necessary information in one location.
CONSTRUCTING THE HGIS PROJECT

The first step in building the HGIS project was to determine what GIS software to use. The two most popular tools on the market are ArcGIS, a proprietary suite of software developed by ESRI and QGIS, the most popular open-source and free GIS software. While QGIS would probably be most useful in the long-term due to better access to the software, ArcGIS was selected due to its ease of use for simple editing and drawing on base maps as well as its widespread adoption among academia and businesses, although in the future there could be an attempt to transfer the map and associated shapefiles to QGIS in order to allow more people to use and modify the project for their own needs.

The next step was creating a map of Constantinople to be used as a foundation where the various data layers would be placed on top. This proved to be a major challenge because there is a lack of maps of Constantinople that would suit the purposes of the HGIS project. The map chosen finally was one that is currently found on the Wikipedia entry of Constantinople. This particular map was chosen for a number of reasons. The main reason was that the sources it used to construct the map were similar to the sources used to locate the churches within the city. In addition, the map was clear enough to show many of the features that were necessary; the major roads, the location of the hills and the city walls. Finally and most importantly, the map was licensed under the

54 These data layers include the churches, monasteries, forums and of course the processional routes.
56 The relevant works of Raymond Janin, Thomas Matthew’s Byzantine Churches in Istanbul Project and Dumbarton Oaks 54 were the primary sources of the map.
GNU Free Documentation License, Version 1.2, meaning that the map was free to modify and distribute as long as the modified copy contained the same license. A major problem with the map however, was the sheer amount of information on the map. This limited its usefulness greatly because any additional information added to the map, such as the data layers, would create an overcomplicated mess of unreadable information. This can be seen in the 1st and 2nd districts near the Hippodrome and Imperial Palace, where much of the roads and terrain was already covered in text from the labels. The first step was to clean up the map, by removing all extraneous objects using Photoshop. See Image II for reference between the original map image and the modified version.

Image II. Original Map Compared to Modified Map

More information regarding the GNU Free Documentation License can be found at http://www.gnu.org/licenses/fdl.html.
As the cleanup process in Photoshop took a number of steps and a good deal of time, a table was created that would keep track of all the versions created in the map cleanup. Image III is a screenshot of the map revisions table which contains information regarding all the updates and modifications of the map including the number of versions created as well as file size and the date of revision.

Image III. Map Versions and Sizes (all files in .PNG format)\(^{58}\)

<table>
<thead>
<tr>
<th>File Name</th>
<th>Modification Changes</th>
<th>Date of Revision</th>
<th>File Size (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Image</td>
<td></td>
<td>January 11th</td>
<td>1.83</td>
</tr>
<tr>
<td>Remake Version (1)</td>
<td>Removed all the churches from the map</td>
<td>February 13th</td>
<td>13.1</td>
</tr>
<tr>
<td>Remake Version (2)</td>
<td>Removed all the monasteries from the map</td>
<td>March 7th</td>
<td>13</td>
</tr>
<tr>
<td>Remake Version (3)</td>
<td>Removed a number of palaces and other buildings</td>
<td>March 13th</td>
<td>13</td>
</tr>
<tr>
<td>Remake Version (4)</td>
<td>Began cleaning up graphical glitches and</td>
<td>March 19th</td>
<td>12.9</td>
</tr>
<tr>
<td>Remake Version (5)</td>
<td>Overlapping colors</td>
<td>March 23rd</td>
<td>12.8</td>
</tr>
<tr>
<td>Remake Version (6)</td>
<td>Final cleanup of the topographical layers. Added layers via Photoshop</td>
<td>March 24th</td>
<td>114.53</td>
</tr>
<tr>
<td>Map with Cadre Markings</td>
<td>Added blue X’s where the processional churches and monasteries were located.</td>
<td>March 25th</td>
<td>114.53</td>
</tr>
<tr>
<td>Completed Map</td>
<td>Removed the Blue X’s from the map, Used PNGQuant to compress the file to a more manageable size.</td>
<td>March 26th</td>
<td>114.53</td>
</tr>
<tr>
<td>Completed Map (compressed)</td>
<td></td>
<td></td>
<td>4.19</td>
</tr>
</tbody>
</table>

With the modified map in hand, the next step was to load the .PNG file into ArcMap 10.1 and then create data layers atop of the base map. Image IV shows the completed map within ArcGIS with all the layers ingested into the program, allowing users to see the locations of the churches and monasteries that were included within the selected processional routes.

Image IV. Completed Map with All Data Layers

Blue = Churches, Purple = Monasteries, Green = Other Processional Locations, Grey = Forums and Yellow = Other religious locations not found in the twenty selected processions.

\(^{58}\) pngquant is a free and open-source software for lossy compression of PNG images. See http://pngquant.org/
Image V includes a screenshot of the data layer table of the HGIS project. This shows the thirteen churches, two monasteries and one miscellaneous location. Each layer can be turned on or off, allowing users to focus on the locations they are interested in. In addition, because Hagia Sophia and Holy Apostles were the two most important churches in Constantinople, their graphical marker is larger than the other churches.

Image V. Data Layers of the HGIS Project

All of these points were created in ArcMap using the draw feature and then converted into features using the “graphics → features” tool which allowed them to become data layers. Each point also contains additional information about the church in question. See Image VI for an example of this.

59 The orphanage of Saint Paul was visited during the feast day of Peter and Paul on June 29th.
The next step after adding all of the points was to map out the actual processional routes. Similarly to the points, the routes were made using the drawing tool, creating lines from the various points on the map. Next, they were converted into features and edited to show
arrows instead of solid lines to indicate direction. Image VII shows the processional route for the feast of Steven, Archbishop of Constantinople, in the ArcMap software.

Image VII A Processional Route (July 18th route)

As the above image shows, it is easy to see that the route begins in Hagia Sophia and ends in Holy Apostles while stopping at the Forum of Constantine along the way. The data layer view also shows the date of the procession and the reason. Similar with the locations markers, each route also contains additional information about the saint or event being commemorated and the processional route. The image below is an example of this.

Image VIII. Additional Processional Route Information
Multiple processional routes can be activated as well, to compare routes or to see which roads or districts were the most commonly included in the *Typikon*. See Image IX showing four processional routes appearing at once.

Image IX. Multiple Processional Routes
One major problem with the HGIS project is the amount of textual information that can be stored within the software. While there are additional tables and text boxes that contain additional information on the processions within the interface, because of the nature of ArcMap and GIS software in general, this data is hidden behind a layer of options and tables making it less accessible to new users. The solution to this problem was to deposit the Excel spreadsheet mentioned previously, which contains additional information, along with the ArcGIS files necessary to view and recreate the HGIS project within the Carolina Digital Repository. The CDR is a repository for works created by the academic community of UNC: CH and will provide long-term access and management for the files, ensuring that the HGIS project will remain usable and understandable for a long period of time.

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60 See Image I on page 14 for a screenshot of this spreadsheet.
61 See Appendix A for more information on the files deposited and how to access the files within the CDR.
CONCLUSION

Creating a HGIS project using medieval Constantinople as the foundation was a challenge due to the difficulties in finding a map, a lack of concrete information on church locations and shifting the shifting topography in the city throughout the centuries. This project can be considered a success however due to the fact that this is a new way of looking at liturgical processions in Constantinople and because it brought together scattered data, many of them not in a digital format, from a variety of sources in order to allow for better understanding of a ritual that was so important and necessary in Byzantine society. Thanks to the power of GIS, this project allows the text of the Typikon of the Great Church, which is all about movement through sacred space and historical urban space, to be rendered “as” movement through the visual interface of the software, As a result, liturgical processions can be better understood by people today, a thousand years after the crowds in Constantinople walked through the streets of the city, transforming the secular roads, shops and houses into sacred space with the chanting of prayers, the smell of incense and the liturgical garments of the clergy.
BIBLIOGRAPHY

Primary Sources


Secondary Sources


APPENDIX A – Deposition of Data in the Carolina Digital Repository

This paper describes a system that contains a number of different digital files to function properly. In order for users to view, use and modify the system, all associated files were deposited within the Carolina Digital Repository (CDR).

The following files are required to recreate and access the HGIS project:

1. **Liturgical Processions** – A .MXD file which contains the map information for the HGIS
2. **Shapefiles** – A folder which contains 130 shapefiles. All of them are needed to reconstruct the points and routes of the HGIS.

The following files are secondary and include additional information on the project:

3. **Complete Map of Constantinople** – A .PNG image that constitutes the base map of the city.
4. **Procession Database** – An Excel Spreadsheet that provides additional information about the churches, events and saints associated with the twenty liturgical processions. In addition, information about the primary and secondary sources is included such as page numbers of the primary and secondary sources.

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62 The CDR can be found at https://cdr.lib.unc.edu/