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The *Fertile Crescent* in Ptolemy's "Geography": a new digital reconstruction for modern GIS tools

Keywords: Claudius Ptolemy, ancient geography, GIS analysis, historical cartography, georeferencing

Summary
The Fertile Crescent was defined by the celebrated U.S. archaeologist J. H. Breasted as a semicircle spanning the territory from the southeast corner of the Mediterranean to the north end of the Persian Gulf and passing through the area located immediately north of Arabia. In the classical Geography by Claudius Ptolemy, this land corresponds to the provinces of Judaea Palestina, Syria, Mesopotamia, and Babylonia, renowned for their ancient civilizations. In this paper, we utilize our mathematical methods involving triangulation, flocking, and Bayesian correction to convert ancient coordinates from Ptolemy's *Geography* into coordinates that can be used directly in modern GIS tools, such as ArcGIS, QGIS, and Google Earth.
We expand our coverage from India and Arabia to the aforementioned regions of the historically important *Fertile Crescent*. Known, unknown, tentatively identified and duplicate points are determined in the study. As part of the digital reconstruction process, the region of interest is surrounded by known points from adjacent regions – Arabia, Cilicia, Cappadocia (including Lesser Armenia), Greater Armenia, Assyria and Susiana. We compare the precision of reconstruction achieved for Ptolemy's *Fertile Crescent* with the precisions that we had computed earlier for his India before the Ganges and provinces of Arabia.
The expansion of the digital reconstruction coverage to the *Fertile Crescent* as described by Claudius Ptolemy represents a novel contribution to the study of our cultural cartographic heritage improving our ability to visualize and explore the ancient world using popular modern GIS tools.

Introduction

This paper presents the results of continuation of our multi-year research of the classical *Geography* by Claudius Ptolemy, a uniquely rich and valuable source that gives coordinates of 6,300+ objects known to the famous ancient astronomer and geographer. These objects include boundary marks (termini), cities, towns, villages, markets, harbors, anchorages, capes, bays, mountains, islands, lakes, river sources, mouths, estuaries, confluences and bends, etc.
In addition to the catalog, Ptolemy provided helpful descriptions and other data, such as the names of the tribes that once inhabited Europe, Africa, and Asia. In this work, we extend the scope of our study to the Fertile Crescent, an area defined as a semicircle that spans the territory from the southeast corner of the Mediterranean to the north end of the Persian Gulf and passes through the lands located immediately north of Arabia (Breasted, 1916). In Ptolemy's *Geography*, this territory corresponds to the provinces of Judaea Palestina, Syria, Mesopotamia, and Babylonia, famous for their ancient civilizations.
This is the first application of our algorithms for numerical analysis of historical data to a region that is largely landlocked. We applied our methods previously to Ptolemy's West Africa (Gusev et al. 2005), Taprobane and India before the Ganges (Abshire et al. 2016, 13–34), and Arabia (Abshire et al. 2016, 133–154). A detailed review of other scientific literature related to the analysis of Ptolemy's *Fertile Crescent* data is provided in the next section of the paper.

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Even though Ptolemy's *Geography* delivers a remarkably detailed and extensive catalog, the tasks involved in its interpretation and visualization are still challenging today. The roots of the difficulty lie in major distortions of the correct shape of *oikouménē,* the inhabited world known to the ancient scientists, and the inevitably compilative nature of Ptolemy's work causing duplicates to appear in the text.

The essential first step toward fulfilling these tasks for the Fertile Crescent involves identifying and georeferencing as many locations as possible, out of 300+ of those found in the Fertile Crescent's Judaea Palestina, Syria, Mesopotamia, and Babylonia. We discuss this painstaking process in the third section of the article.

The second step of the process accomplishes placement of the points that could not be directly identified and georeferenced, conclusively or tentatively. Taking an approach similar to that developed for Arabia, where we surrounded its northern part with known points from the *Fertile Crescent*, we added to our model the known points from all adjacent regions – Arabia, Cilicia, Cappadocia (including Lesser Armenia), Greater Armenia, Assyria and Susiana, in order for our triangulation method with Bayesian adjustment to work well.

This step covered in the fourth section involved 300+ points in Arabia, which we dealt with before, along with examining 400+ points located in the five newly engaged provinces.

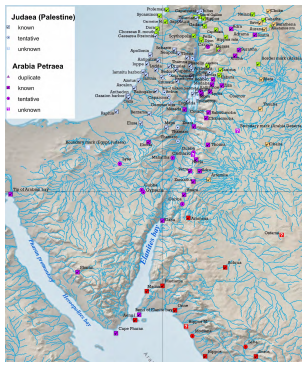
The fifth section of the paper provides a brief discussion of the relatively minor impact of our Bayesian adjustment on the results obtained for the mostly, but not entirely landlocked Fertile Crescent region.

We expected that the precision of digital reconstruction that our methods can attain would vary from region to region, according to the quality and quantity of the ancient knowledge about each region, and in line with our own capability to identify and georeference locations in the region. The sixth section of our work is devoted to the comparison of the precision of reconstruction achieved for Ptolemy's Fertile Crescent against the precisions that we had computed earlier for his India and Arabia.

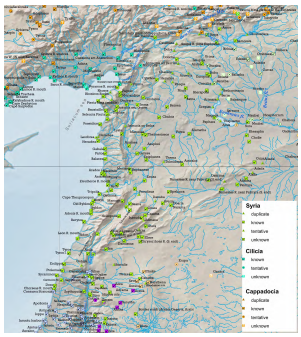
Figs. 1-4 provide a visual representation of our results achieved for Ptolemy's Fertile Crescent. The reader can also see Arabia Petraea, Susiana, and most of Assyria in the maps. We draw conclusions and outline the future research directions in the final section of the paper.

The following four full-page visual representations are depicting:

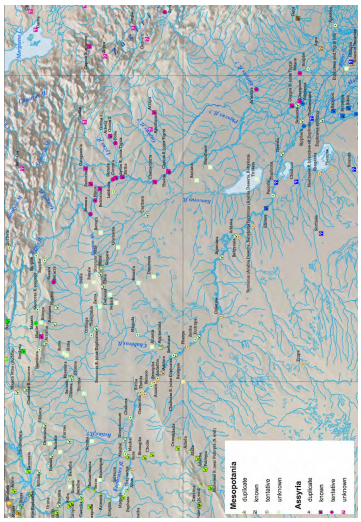
a. Judaea (Palestine), Arabia Petaea
b. Sysia, Cylicia, Cappadocia
c. Mesopotamia, Assyria
d. Babylonia, Susiana



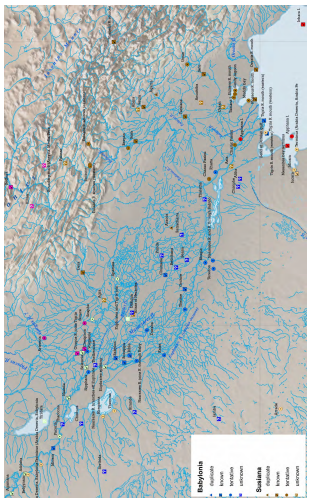
a.



b.



c. *(Anticlockwise)*



d. *(Anticlockwise)*

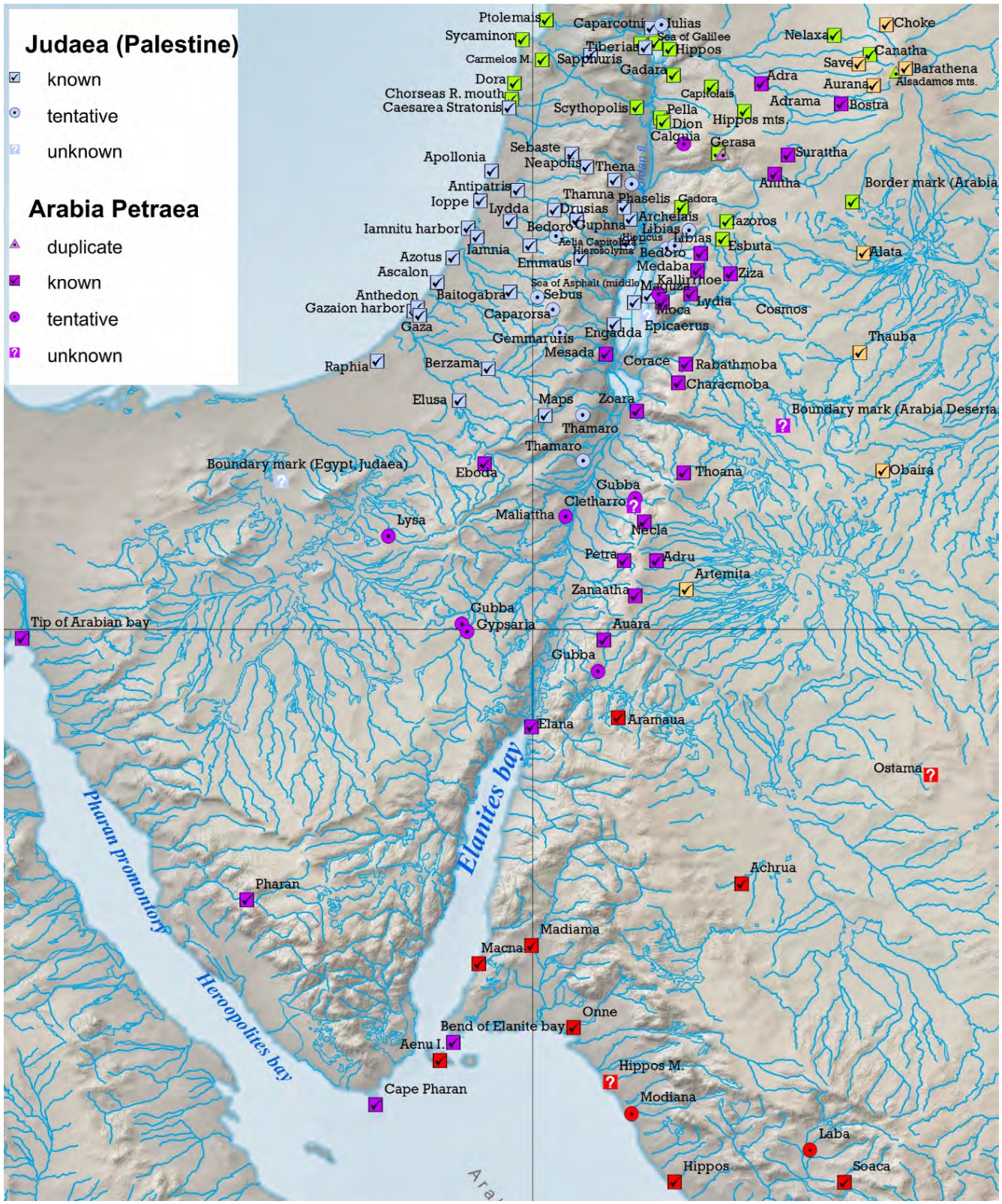


Figure 1. Ptolemy's Judaea Palestina and Arabia Petraea.

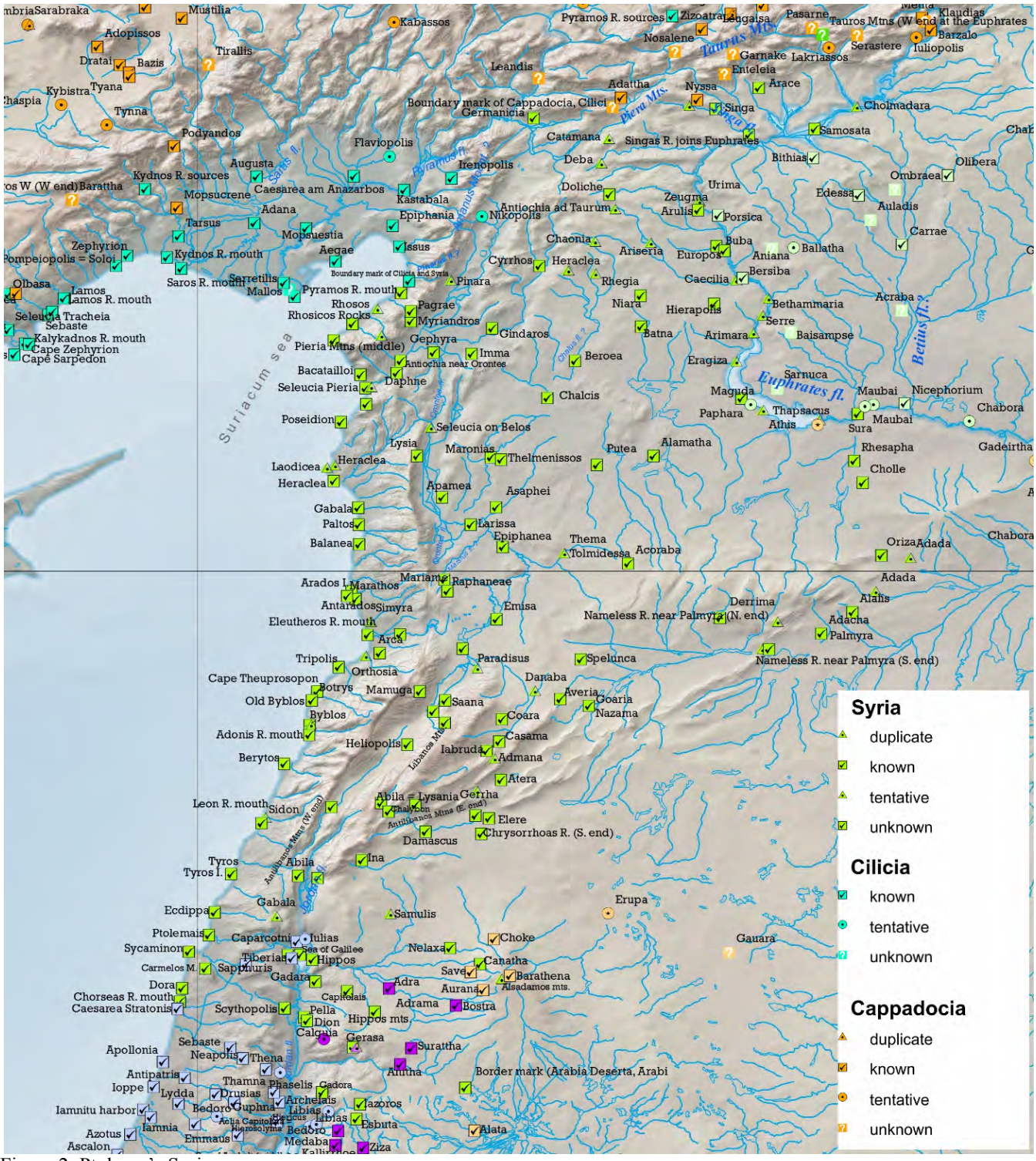


Figure 2. Ptolemy's Syria.

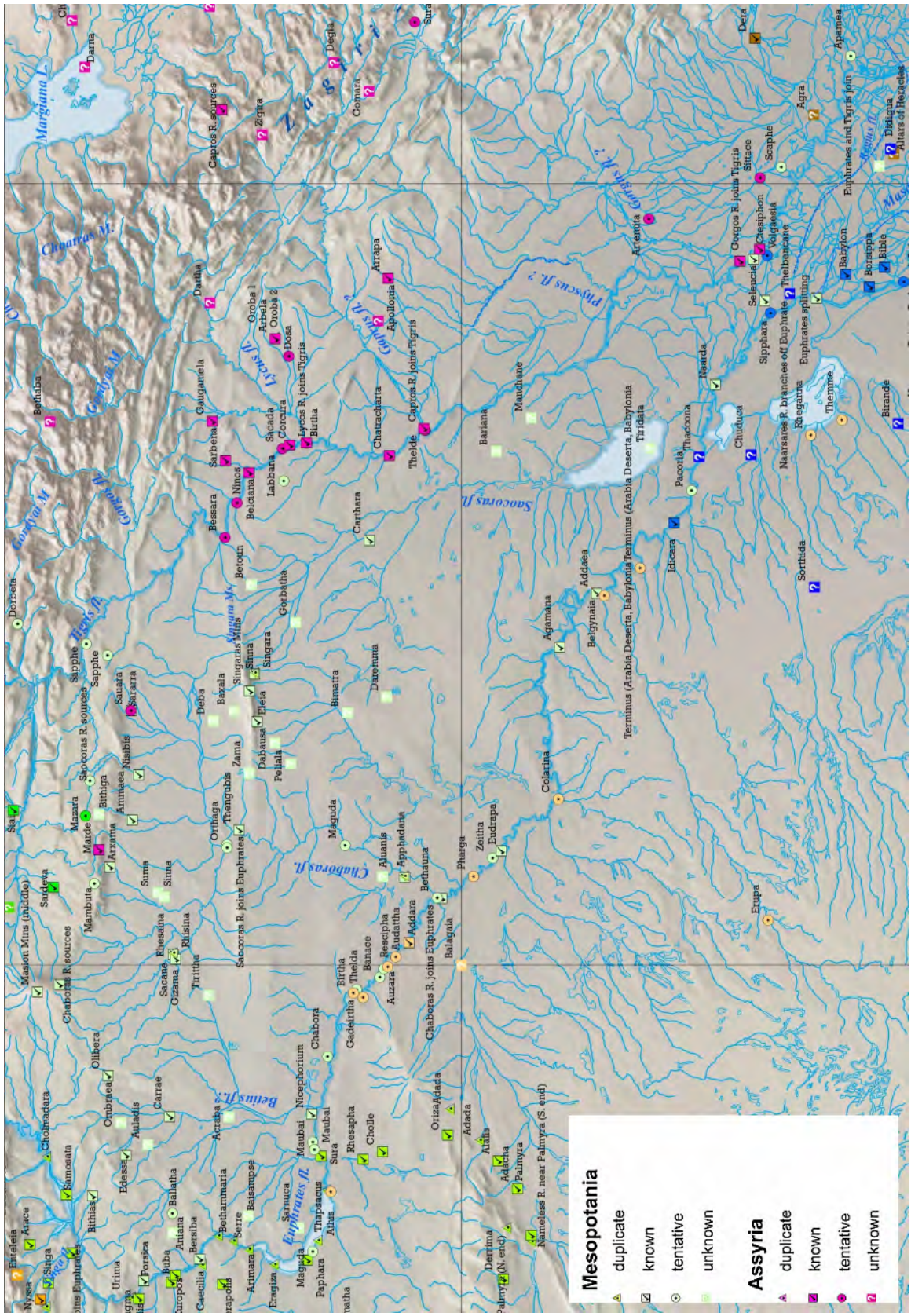


Figure 3. Ptolemy's Mesopotamia.

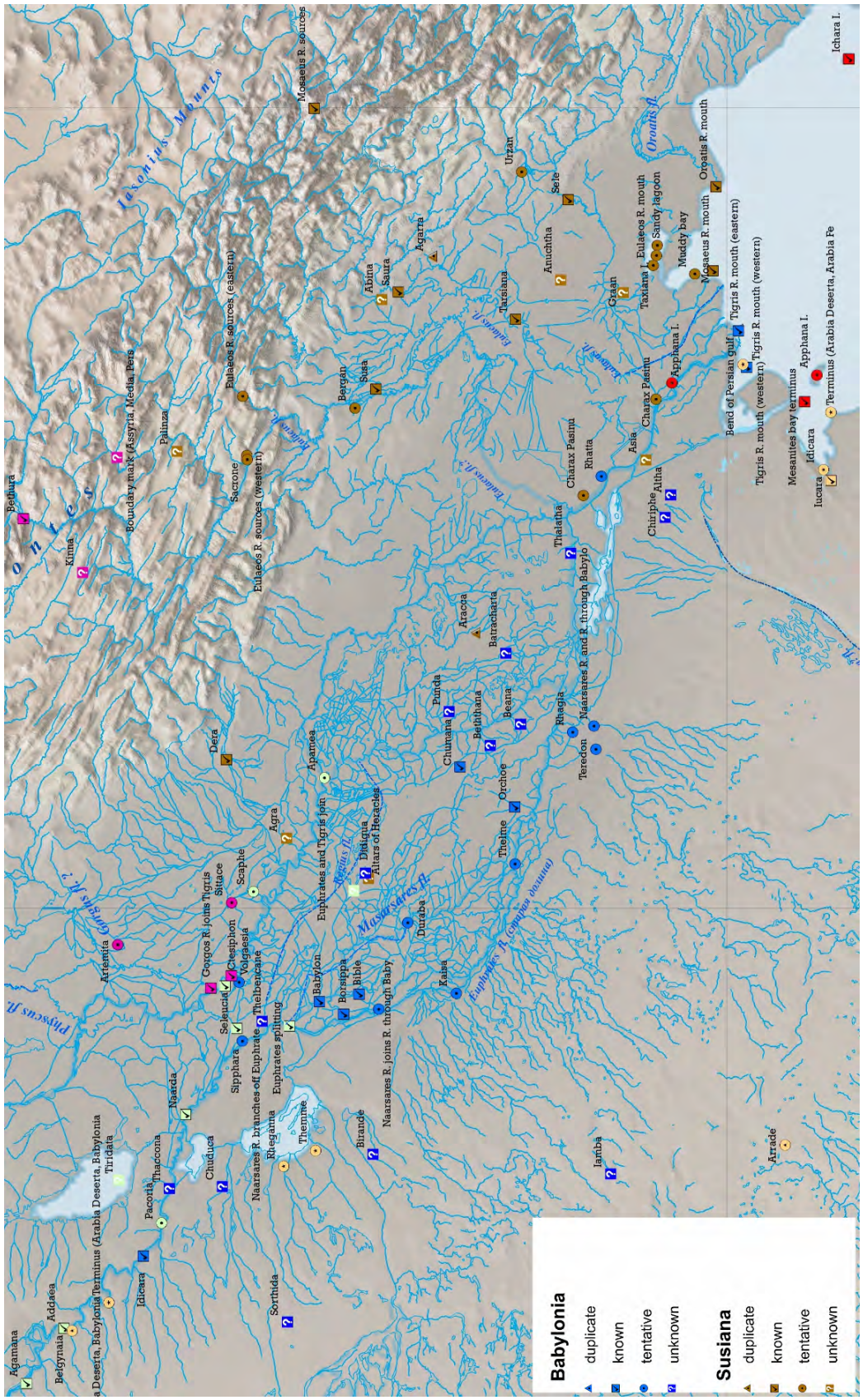


Figure 4. Ptolemy's Babylonia and Susiana.

Literature Review

The best available complete translation of Ptolemy's *Geography* into a modern European language (German) is by Stückelberger & Grasshoff (2006). The preparation of this translation involved thorough comparison of several extant Greek manuscripts of *Geography*. Stückelberger and Grasshoff include an authoritative Greek version of the original text printed side-by-side with the German translation. In our work, we have used the electronic database of coordinates accompanying the monograph and adopted its object IDs. Conveniently, Stückelberger and Grasshoff suggest modern names for many objects mentioned by Ptolemy. However, we observed that in the *Fertile Crescent* area and the neighboring regions their identifications often originated from the notes found in a much older *Geography* translation by Müller (1883-1901). Unfortunately, the only complete English translation by E. L. Stevenson (Ptolemy 1991) has long been known to be of remarkably poor quality (Diller 1935). For instance, many place names in that translation are latinised unnecessarily. Nevertheless, we used this source, too, along with the Greek original, in order to come up with appropriate translations of the German names into English, with as little latinisation as possible.

We found Talbert (2000) and Åhlfeldt (2017) to be outstanding sources for point identification. Together, they provide excellent coverage of the Fertile Crescent area. It should be noted that the spellings of ancient names preferred by these two resources often differ from those found in Ptolemy's *Geography*. The remarkable modern catalog by Tsorlini (2011) covers Ptolemy's Mediterranean and Black Sea region, while offering a methodology for derivation of modern coordinates.

In addition to the modern publications, we used such classic sources on the Fertile Crescent as (d'Anville and Horlsey 1791), (Colton 1855), and (Johnson 1870).

Among the publications that do not deal with the Fertile Crescent area, yet provide better understanding of Ptolemy's methods and his overall approach, we must mention (Berggren and Jones 2000) that contains an almost complete reconstruction of Ptolemy's Gallia (Celtogalatia). Many references to other works related to the numerical analysis of ancient maps are provided in the literature reviews included in our papers on Ptolemy's India and Arabia (Abshire et al. 2016, 13–34; Abshire et al. 2016, 133–154). In the next section of this paper, we will discuss issues pertinent to point identification.

Point Identification

We continued to apply the point classification introduced in our paper on Ptolemy's Arabia (Abshire et al. 2016, 133–154) and divide all Ptolemy points into four categories: *known* points, *tentatively identified* points, *unknown* points, and *duplicates*.

Identification of Known Points

It proved relatively easy to identify many known points in Judaea Palestina. This small province has been extensively studied by the archaeologists, so some doubts still remain about only 11 points out of 44 (a boundary mark excluded), namely, Iulias (et Tell?), Drusias, Sebus (Khirbat Bayt Nasib?), Bedoro (possibly, Bayt Ghur al-Foqa or Tall ar Rāmah), Thamaro (Ir Ovot or Mezad Thamar), Cosmos (Tall aş Şimādī?), Libias (possibly, Tall ar Rāmah or Tall al Ḩammām), Iazoros (Qasr Al-Abd?), Epicaerus, Caparorsa (Hebron?), and Gemmaruris (Al Karmil?). In other words, ~73% of Ptolemy objects in Judaea Palestina are known with certainty.

Syria was investigated pretty well, too. According to our classification, 99 of its 162 Ptolemy points are labeled known (~61%). The situation deteriorates drastically in the neighboring Mesopotamia, where we can be certain about 29 out of 79 locations (~37%). The known points in Mesopotamia include Ptolemy's Naarda (the Nehardea archaeological site) overlooked by Stückelberger and Grasshoff. Also among the known are such famous archaeological sites as Ptolemy's Eudrapa (Dura Europos), Sipphara (Sippar), Se-

leucia, Singara (Sinjar, where Soviet archaeologists worked in the 1980s), Carthara (Hatra, al-Hadr), Nisibis (Nusaybin), and Carrae (Harran).
Finally, in Babylonia, Ptolemy names 33 data points, and we were only able to establish identity of 8, or about 24% of them. Those are the two mouths of the Tigris (eastern and western, also duplicated in Susiana) and Ptolemy's cities of Bible (alternatively spelled "Bilbe", the ancient Dilbat, excavated at Tell al-Deylam), Idicara (Hit, a town located near the point where Wadi 'Īdī flows into the Euphrates), Babylon (famously excavated by Robert Koldewey at Tell Babil), Borsippa (Birs Nimrud), Chumana (alternatively spelled "Phumana", Umma, modern Tall Umm al 'Ajāyib), and Orchoe (Uruk, excavated at Warkā).
The size limit imposed on this paper prevents us from discussing all identifications of the known objects. The tables of modern coordinates for known locations in Ptolemy's Judaea Palestina, Syria, Mesopotamia, and Babylonia are placed in Appendix A at the end of the paper.

Identification of Duplicates

No duplicates were found in Judaea Palestina. In Syria, the five duplicates are as follows. Stückelberger and Grasshoff (2006) and Talbert (2000) believe that Arulis is a duplicate of Urima. They also claim that Ptolemy's Nazama is a duplicate of his Goaria, modern Al Quaryatayn. Talbert (2000) calls this place Nazala. Paphara is believed to be a duplicate of Arimara. Stückelberger and Grasshoff believe Thema to be a duplicate of Tolmidessa, which they identify with the known Theleda. However, the identification of Tolmidessa with Theleda is questionable. There is an ancient place called Salamias nearby. It is also possible that Tolmidessa is a duplicate of Thelmenissos. Ptolemy's Adra (the modern Daraa) in Syria has two duplicates — Adra in Arabia Petraea and Adrama in Syria.
In Mesopotamia, Sacane is a duplicate of Rhisina and Rhesaina; not Sehan (Ceyhan, Turkey) suggested by Stückelberger and Grasshoff. This place is presently known as Ra's al 'Ayn, or Sari Kani. Ombraea is a likely duplicate of Olibera, which Stückelberger and Grasshoff identified with Barbare. Ptolemy's Sinna is a duplicate of Singara (Sinjar). This is definitely not Senn (al-Sinn) located at the mouth of Nahr Senn canal, across from the mouth of the Little Zab River in Assyria. Apphadana (Al Faydan) occurs twice, with different coordinates. In Babylonia, the coordinates for the eastern mouth of the Tigris are listed twice.

Tentative Identification

In Syria, we tentatively place the Euphrates bridge near the ancient Thapsacus in the vicinity of Al Tabqah, the old town also known under its newer name Al-Thawrah ('the revolution'). Ptolemy's Antiochia ad Taurum is likely Gaziantep, formerly Aïntab. We tentatively identify Pinara as the modern Deliçay, as it should be located somewhere on the Pinaros/Deli Çayi/Deli Çay river. We tentatively identify Heraclea as Kilis. We tentatively accept the suggestion by Stückelberger and Grasshoff that Ptolemy's Bethammaria might be the modern Qal'at Najm, even though Caecilia (Caeciliana) has also been suggested. Ptolemy's Serre (Gerrhe) tentatively corresponds to the ruins between Ṣandalīyah aṣ Ṣaghīrah and Ṣandalīyah al Kabīrah, two small populated places. Arimara likely corresponds to the extensive ruins located at Jabal Umm Mughr, 3 km south of Jenf al Aḫmar, a place that was flooded by Lake Al Assad reservoir. Eragiza (Tall al Ḫājj) must have been flooded by the reservoir as well. Either Ptolemy's Old Byblos is located just inland from Byblos, or Edde is Old Byblos. The Gabala tentatively identified as Jish is a likely duplicate of another Gabala. Samulis is tentatively identified as Simlin, based on the name similarity, despite that town's being out of place. Ptolemy's Adada is either As Sukhnah (Stückelberger and Grasshoff 2006), or, less likely, the magnificent ancient ruins of Qasr al-Hayr al-Sharqi (Talbert 2000). The castle is dated by the Umayyad time, though. For Danaba, we tentatively favor its being Sadad (Stückelberger and Grasshoff 2006), despite a conflicting identification proposed by Talbert (2000). Talbert (2000) and Stückelberger and Grasshoff (2006) also propose two conflicting identifications for the modern Al Qastal, the one equating it to Ptolemy's Admana (Talbert 2000) making more sense to us.

In Mesopotamia, we tentatively identify Ptolemy's Saocoras River as the modern Jaghjagh, even though it does not currently reach the Euphrates. For Ptolemy's Maguda, Stückelberger and Grasshoff suggest Marqadah, and we found two different places by the name of Marqadah, or Tell Marqada (=Tell Markhada). It is not obvious to us which of the two is the right one. Ptolemy places the town of Chabora at the place where the Chaboras River joins the Euphrates, so the town is commonly identified as the ancient Circesium, modern Busaira. However, we prefer to identify Busaira as Ptolemy's Bethauna, with the suspicion that it might be a corrupted "Bethaura" (ρ instead of ν). Given Chabora's positioning relative to the nearby known towns of Harran (Ptol. Carrae), Barbalissos (Ptol. Barbarissus), Sura, Resafa (Ptol. Rhesapha), and Dura Europos (Ptol. Eudrapa), we disagree with Ptolemy by tentatively placing Chabora near the modern village called Judaydat (Jdaydet) Khabur. Here the word "judaydat" means 'village'. Meanwhile, we tentatively suggest that Ptolemy's Rescipha is not a duplicate of his Rhesapha. It should instead be sought near the modern Ruṣāfah. Müller (1883-1901) proposed an identification of Ptolemy's Pacoria with the place once named Bariah, or Barije. We found this place on old maps and traced its location to the modern Kurd Ḫamad Nāyif. The identification, however, remains uncertain. Ptolemy's Sapphe could be the modern Özen (formerly Bâbil), as Åhlfeldt (2017) suggested, or Hendekköy, as Stückelberger and Grasshoff proposed. For Ptolemy's Labbana, we suggest ruins near Jabal Qalbān, instead of the ruins of Assur near modern Al-Shirqat, Ash Sharqāṭ, known as Qal'at Sherqat, Qalaat Sergat. That earlier, incorrect identification was proposed in the 19th century. We tentatively identify Assur, an Assyrian city, as Ptolemy's Chatracharta in Assyria. D'Anville and Horsley (1791) identified Ptolemy's second Birtha as Tikrit. Edward Gibbon, a celebrated 18th century historian, held the same opinion. Birtha means 'fortress' in Syriac. However, the fortifications near Tikrit are nowadays dated by the later times of the Sassanid dynasty. Given the positioning of Birtha relatively to Carthara (Hatra) and the mouth of the Lycos River (the Great Zab), we tentatively suggest the ruins of Naef at Tall al Mishrāq instead. We tentatively identified Ptolemy's first Birtha with the ruins of the ancient fortress of Zenobia located near the present day Halabiyah. We tentatively identify Ptolemy's Orthaga as the known archaeological site Tell al-Hassaka at Al Hasakah.
In Babylonia, contrary to Stückelberger and Grasshoff, there is no reason to believe that Ptolemy's Teredon was located at the site of present-day Basrah. The mysterious Teredon reportedly stood at the mouth of the Euphrates (sic!) to the Persian Gulf and was an important port city in the realm of Characene. We tentatively identify Teredon as the known archaeological site of Eridu. This proposed identification is very uncertain! We tentatively identify Ptolemy's Duraba, which we do not believe to be Dilbat, as the modern Orouba. We consider Ptolemy's Chuduca (alternatively spelled "Chryduka") a likely match to the ruins at Tall Churkhah, 6.6 km NW from his Chumana (Umma, the ruins at Tall Umm al 'Ajāyib). Ptolemy's Kaisa we tentatively identify as Al Qadisiyah, a historical city most famous as the site of the Battle of al-Qādisiyyah fought circa 636 AD. Finally, we propose to link Ptolemy's Thelme to the known ruins at Samawah.
The tentative identifications proposed are too numerous to list and discuss all of them here.

Surrounding the *Fertile Crescent*

While many modern matches are known to the places in the *Fertile Crescent* that were mentioned by Claudius Ptolemy in *Geography*, a few of them remain unknown, especially in Mesopotamia and Babylonia. Our *triangulation model* (Abshire et al. 2016, 13–34) uses three Ptolemy points with known modern coordinates to form a spherical triangle surrounding a point that is to be predicted. The model then triangulates to find the unknown point's approximate modern coordinates. The method works well, but the restriction that requires each of the unknown places intended for processing to be enclosed by a spherical triangle formed by known points cannot be met for many points located on the borders of the area being investigated. In order to remedy this problem for Arabia, we surrounded its northern part with the known points

from Ptolemy's Judaea Palestina, Syria, Mesopotamia, and Babylonia (Abshire et al. 2016, 133–154). For Arabia Felix, we used the known points from Arabia Petraea and Arabia Deserta to surround it.
Now the turn of Judaea Palestina, Syria, Mesopotamia, and Babylonia has come. In addition to the three provinces of Arabia, we have assembled known points for all other regions surrounding the *Fertile Crescent*, namely, Cilicia, Cappadocia, Greater Armenia, Assyria, and Susiana.

Bayesian Adjustment

Having applied triangulation and flocking, we post-processed the results using our *Bayesian adjustment* technique initially developed for India (Abshire et al. 2016, 13–34) with the prior shown in Figure 5. This way, we made sure that the points located near the coastline were not placed in the sea. The coastline of the *Fertile Crescent* is relatively short and well known, so the benefit of Bayesian adjustment proved small, when compared to the earlier cases of the island of Taprobane (Sri Lanka) and the peninsular Arabia Felix and India before the Ganges. The prior developed previously for Arabia sufficed here.

Figure 5. The Bayesian calculation prior (Source: Abshire et al. 2016, 133–154).

Precision Analysis

In our earlier paper (Abshire et al. 2016, 13–34) we offered a prediction that the precision numbers for our digital prediction methods in other regions might surpass those reached in Ptolemy's India before the Ganges. In our *flocking model* introduced in (Abshire et al. 2016, 13–34) and modified subsequently to improve its precision (Abshire et al. 2016, 133–154), we take the k known nearest neighbors of the unknown point and use their distances from the unknown point in order to compute weighted average of the move-

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ment. The resulting averaged vector is then used to move the unknown point and arrive at its approximate modern match. Error histograms for the take-one-out known point predictive analysis using the flocking model with Bayesian adjustment for Judaea Palestina, Syria, Arabia Petraea and India before the Ganges are shown in Figure 6. Clearly, the new results further confirm validity of our prediction.

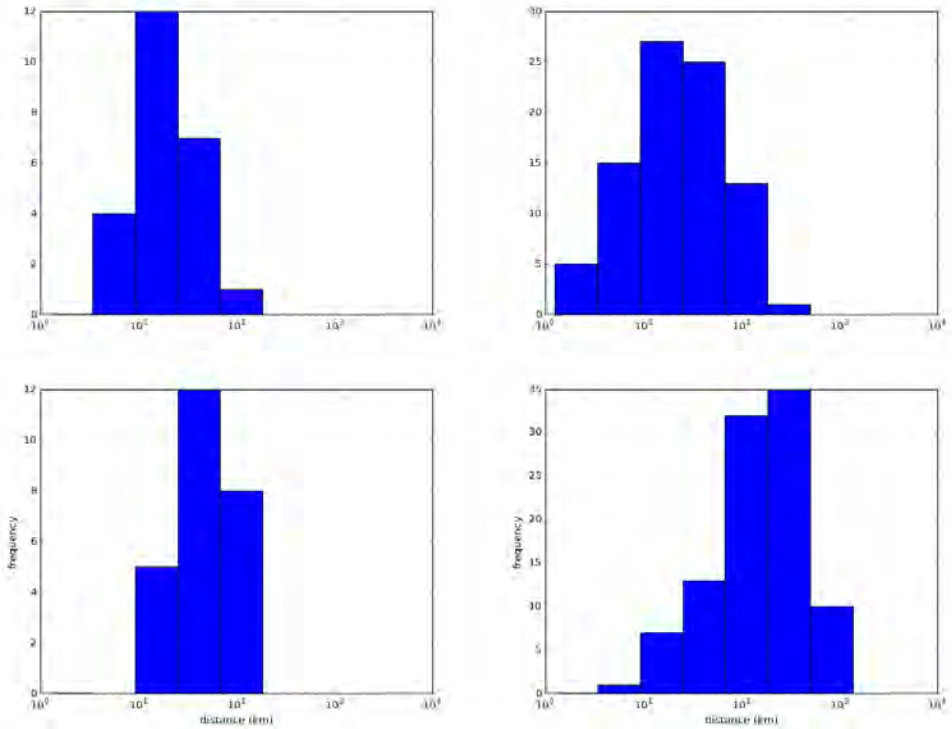

Figure 6. Error histograms for Judaea Palestina (left top), Syria (right top), Arabia Petraea (left bottom) and India before the Ganges (right bottom) for the flocking model with Bayesian adjustment. (Arabia and India Source: Abshire et al. 2016, 133–154).

Conclusions and Future Work

We extended application of our computational methods for numerical analysis of historical data from Ptolemy's *Geography* to the area known as the *Fertile Crescent* (Judaea Palestina, Syria, Mesopotamia, and Babylonia). This achievement allowed us to conduct the additional model validation, along with more region-to-region comparison of predictive performances of our two models (triangulation and flocking). Our results represent a novel research contribution that helps improve our understanding of historical cartographic heritage by using popular and accessible GIS tools, such as ArcGIS, QGIS, and Google Earth, to explore the "known world" of the ancients as it was preserved for us by Claudius Ptolemy, a celebrated ancient astronomer and geographer.

In the future, we intend to apply our digital techniques to more regions from Ptolemy's *Geography*. We also plan to modify our algorithms to improve tentative identification verification. Given the amount of uncertainty remaining as to some ancient locations, such as the Altars of Heracles, it would be great to see archaeologists eventually discover more lost ancient objects mentioned by Ptolemy in the currently unstable region of Mesopotamia and in other parts of the *Fertile Crescent*.

Acknowledgments

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Appendix. Tables of Known Points

Table 1. Modern coordinates for known locations in Judaea Palestina (Book 5 Chapter 16).

Ptolemy ID	*Ptolemy Name*	*Modern Name*	*Ptol. Lat.*	*Ptol. Lon.*	*Mod. Lat.*	*Mod. Lon.*
5.16.02.02	Caesarea Stratonis	Caesarea	32.50	66.25	32.4988	34.8913
5.16.02.04	Apollonia	Tel Arshaf	32.25	66.00	32.1953	34.8066
5.16.02.05	Ioppe	Jaffa	32.08	65.67	32.0537	34.7521
5.16.02.06	Iamnitu harbor	Yavne-Yam	32.00	65.00	31.9228	34.6941
5.16.02.07	Azotus	Ashdod	31.83	65.25	31.7802	34.6216
5.16.02.08	Ascalon	Ashqelon	31.67	65.00	31.6629	34.5477
5.16.02.09	Gazaion harbor	al-Minah	31.50	64.92	31.5240	34.4336
5.16.02.11	Anthedon	Teda	31.67	64.83	31.5427	34.4514
5.16.03.03	Sea of Asphalt (middle)	Dead Sea	31.17	66.83	31.5660	35.4898
5.16.04.02	Sapphuris	Sepphoris	32.42	66.67	32.7517	35.2814
5.16.04.03	Caparcotni	Capernaum	32.08	66.83	32.8802	35.5717
5.16.04.05	Tiberias	Tiberias	32.08	67.25	32.7869	35.5427
5.16.05.02	Neapolis	Nablus	31.83	66.83	32.2165	35.2629
5.16.05.03	Thena	Khirbat Ṭānā	31.75	67.08	32.1526	35.3950
5.16.06.03	Raphia	Rafah	31.50	65.00	31.2867	34.2575
5.16.06.04	Gaza	Gaza	31.75	65.42	31.5040	34.4620
5.16.06.05	Iamnia	Yavne	32.00	65.67	31.8805	34.7381
5.16.06.06	Lydda	Lod	32.00	66.00	31.9549	34.8959
5.16.06.07	Antipatris	Tel Ras el-'Ain	32.00	66.33	32.1048	34.9308
5.16.06.09	Sebaste	Sebastiya	32.33	66.67	32.2768	35.1922
5.16.06.10	Baitogabra	Beit Guvrin	31.50	65.50	31.6165	34.8968
5.16.07.01	Emmaus	Imwas	31.75	65.75	31.8393	34.9893
5.16.07.02	Guphna	Jifna	31.75	66.17	31.9623	35.2152
5.16.07.03	Archelais	Khirbet el-Beiyudat	31.75	66.50	31.9660	35.4717
5.16.07.04	Phaselis	Khirbet Fasayil	31.58	66.92	32.0227	35.4406
5.16.07.05	Hiericus	Jericho	31.92	66.75	31.8547	35.4595
5.16.08.01	Aelia Capitolina = Hierosolyma	Jerusalem	31.67	66.00	31.7767	35.2342
5.16.08.02	Thamna	Khirbet Tibne	31.50	66.25	32.0085	35.1067
5.16.08.03	Engadda	Ein Gedi	31.25	66.50	31.4614	35.3924
5.16.09.04	Kallirrhoe	'Ain ez-Zara	31.17	67.08	31.5967	35.5587
5.16.10.03	Berzama	Be'er Sheva	31.25	64.83	31.2511	34.7911
5.16.10.06	Elusa	Haluza	30.83	65.17	31.0978	34.6510
5.16.10.07	Maps	Mamshit	30.92	65.67	31.0253	35.0644

Table 2. Modern coordinates for known locations in Syria (Book 5 Chapter 15).

Ptolemy ID	*Ptolemy Name*	*Modern Name*	*Ptol. Lat.*	*Ptol. Lon.*	*Mod. Lat.*	*Mod. Lon.*
5.15.02.05	Alexandria near Issus	Iskenderun	36.08	69.50	36.5887	36.1679
5.15.02.07	Rhosos	Arsuz	35.67	69.33	36.4121	35.8913
5.15.02.08	Rhosicos Rocks	Akıncı Burun	35.83	69.00	36.3169	35.7834
5.15.02.09	Seleucia Pieria	Çevlik	35.58	68.58	36.1222	35.9348
5.15.03.01	Orontes R. mouth	Asi R.	35.50	68.50	36.0450	35.9638
5.15.03.02	Orontes R. sources	near Laboue	33.33	70.00	34.1973	36.3524

5.15.03.03	Poseidion	Ras al Basit	35.25	68.50	35.8499	35.8247
5.15.03.05	Laodicea	Latakia	35.08	68.50	35.5139	35.7821
5.15.03.06	Gabala	Jablah	34.92	68.33	35.3617	35.9243
5.15.03.07	Paltos	Arab al Mulk	34.75	68.33	35.2651	35.9256
5.15.03.08	Balanea	Baniyas	34.50	68.33	35.1535	35.9282
5.15.04.02	Eleutheros R. mouth	Nahr el Kebir	34.42	68.00	34.6338	35.9768
5.15.04.05	Tripolis	Al Mina	34.33	67.50	34.4508	35.8123
5.15.04.06	Cape Theuprosopon	Râs ech Chaqaa	34.25	67.33	34.3100	35.6876
5.15.04.07	Botrys	Batroun	34.08	67.50	34.2594	35.6575
5.15.04.08	Byblos	Jbaïl	33.92	67.67	34.1190	35.6457
5.15.04.09	Adonis R. mouth	Nahr Ibrahim	33.75	67.67	34.0651	35.6432
5.15.05.01	Berytos	Beirut	33.67	67.50	33.8979	35.5012
5.15.05.03	Sidon	Saida	33.50	67.17	33.5603	35.3708
5.15.05.04	Tyros	Tyre	33.33	67.00	33.2693	35.1959
5.15.05.05	Ecdippa	Achziv	33.25	67.17	33.0486	35.1019
5.15.05.06	Ptolemais	Acre	33.00	66.83	32.9207	35.0686
5.15.05.07	Sycaminon	Tel Shikmona	32.83	66.83	32.8245	34.9556
5.15.05.08	Carmelos M.	Mount Carmel	32.92	66.42	32.7296	35.0498
5.15.05.09	Dora	Tel Dor	32.67	66.50	32.6163	34.9163
5.15.05.10	Chorseas R. mouth	Naḥal Tanninim	32.58	66.33	32.5391	34.9024
5.15.08.03	Cassius Mtns (middle)	Mount Aqraa	34.75	68.75	35.9521	35.9692
5.15.09.05	Chrysorrhoas R. (N. end)	Wadi Barada	33.50	69.25	33.6751	36.0528
5.15.09.06	Chrysorrhoas R. (S. end)	Nahr Baradá	32.00	69.75	33.4980	36.6261
5.15.09.08	Lake of Gennesaret	Sea of Galilee	32.33	67.67	32.8072	35.5929
5.15.09.11	Singas R. joins Euphrates	Çakırhüyük Dere	37.67	72.00	37.4933	38.1557
5.15.10.06	Singa	Üçgöz	37.50	71.00	37.6413	37.9659
5.15.10.07	Germanicia	Kahramanmaraş	37.00	70.00	37.5871	36.9254
5.15.10.09	Doliche	Dülük	36.67	70.67	37.1518	37.3595
5.15.11.03	Samosata	near Samsat	37.92	71.50	37.5258	38.5304
5.15.12.03	Pagrae	Bakras Kalesi	36.58	70.00	36.4267	36.2249
5.15.12.04	Syrian Gates	Belen Geçidi	36.25	69.67	36.4835	36.2252
5.15.13.07	Hierapolis	Manbij	36.25	71.25	36.5254	37.9575
5.15.13.08	Cyrrhos	Nebi Houri	36.00	70.17	36.7442	36.9591
5.15.13.09	Beroea	Aleppo	36.00	70.50	36.1995	37.1620
5.15.13.10	Batna	Tall Buṭnān	36.00	70.83	36.3953	37.5392
5.15.14.04	Zeugma	Zeugma	37.00	72.00	37.0603	37.8655
5.15.14.05	Europos	Jarabulus	36.83	72.00	36.8288	38.0158
5.15.15.02	Gephyra	Demirköprü	35.50	69.50	36.2496	36.3544
5.15.15.03	Gindaros	Jindayris	35.67	70.00	36.3854	36.6886
5.15.15.04	Imma	Yenişehir	35.42	69.83	36.2415	36.5696
5.15.16.02	Antiochia on Orontes	Antakya	35.50	69.00	36.2008	36.1653
5.15.16.06	Lysia	Qal'at Marzā	35.00	69.50	35.6578	36.2608
5.15.16.09	Larissa	Shayzar	34.58	69.67	35.2657	36.5664
5.15.16.10	Epiphanea	Hamah	34.42	69.58	35.1359	36.7495
5.15.16.11	Raphaneae	al-Rafanīya	34.25	69.25	34.9500	36.4158
5.15.16.12	Antarados	Tartus	34.25	68.25	34.8852	35.8838
5.15.16.13	Marathos	Amrit	34.42	68.67	34.8387	35.9069

5.15.16.14	Mariame	Maryamayn	34.00	69.33	34.8851	36.4337
5.15.17.03	Acoraba	Uqayribat	35.25	71.25	35.0427	37.4643
5.15.17.05	Chalybon	Halbon	35.00	71.33	33.6644	36.2483
5.15.17.08	Barbalissos	Tell Meskene	35.75	71.92	35.9865	38.1130
5.15.18.02	Chalcis	Qinnasrin	35.67	70.50	35.9897	37.0036
5.15.18.05	Maronias	Ma'arat al-Nu'man	34.50	71.17	35.6491	36.6797
5.15.18.06	Coara	Qarah	34.17	70.83	34.1542	36.7442
5.15.19.04	Thelmenissos	Talmenes	35.00	69.67	35.6372	36.7379
5.15.19.05	Apamea	Afamiyah	34.75	70.00	35.4201	36.4018
5.15.19.06	Emisa	Homs	34.00	69.67	34.7234	36.7144
5.15.20.02	Laodicea Scabiosa	Tall an Nabī Mindū	33.75	69.67	34.5556	36.5188
5.15.20.04	Iabruda	Yabrud	33.50	70.00	33.9719	36.6562
5.15.21.02	Arca	Tallet Aarqa	34.00	68.50	34.5305	36.0468
5.15.21.05	Caesarea Panias	Banias	33.00	67.67	33.2462	35.6922
5.15.22.03	Heliopolis	Baalbek	33.67	68.67	34.0067	36.2037
5.15.22.04	Abila = Lysania	Souk Wadi Barada	33.33	68.75	33.6264	36.0978
5.15.22.05	Saana	Ras Baalbek	33.42	69.33	34.2591	36.4191
5.15.22.06	Ina	Heeneh	33.00	68.50	33.3490	35.9435
5.15.22.07	Damascus	Damascus	33.00	69.00	33.5114	36.3074
5.15.22.09	Abila	Tel Avel Beit Ma'akha	32.75	68.25	33.2593	35.5803
5.15.22.10	Hippos	Tel Susita	32.50	68.00	32.7785	35.6602
5.15.22.11	Capitolias	Bayt Ra's	32.50	68.75	32.5984	35.8583
5.15.22.12	Gadara	Umm Qais	32.17	68.00	32.6555	35.6780
5.15.23.01	Adra	Daraa	32.17	68.67	32.6126	36.0994
5.15.23.02	Scythopolis	Beit She'an	31.92	67.67	32.5021	35.5020
5.15.23.03	Gerasa	Jarash	31.75	68.25	32.2806	35.8917
5.15.23.04	Pella	Tabaqat Fahl	31.67	67.67	32.4495	35.6158
5.15.23.06	Gadora	Tell Jadur	31.50	67.75	32.0222	35.7165
5.15.23.07	Philadelpheia	Amman	31.33	68.00	31.9541	35.9343
5.15.23.08	Canatha	Qanawat	31.75	68.83	32.7542	36.6185
5.15.24.02	Rhesapha	Resafa	34.75	72.25	35.6287	38.7580
5.15.24.03	Cholle	Khoulle	34.50	71.75	35.5038	38.8054
5.15.24.04	Oriza	Al Taibah	34.50	72.25	35.0885	38.9139
5.15.24.07	Palmyra	Palmyra	34.00	71.50	34.5532	38.2701
5.15.24.08	Adacha	Arak	34.00	72.00	34.6430	38.5690
5.15.24.10	Goaria	Al Quaryatayn	33.50	70.50	34.2285	37.2403
5.15.24.11	Averia	Hawwarin	33.67	71.50	34.2690	37.0769
5.15.24.12	Casama	An Nabk	33.33	70.67	34.0249	36.7282
5.15.25.02	Alalis	Hulayhilah	35.25	72.33	34.7653	38.7485
5.15.25.03	Sura	Sura	35.67	72.67	35.8969	38.7790
5.15.25.04	Alamatha	Al Hammam	35.08	73.00	35.6576	37.6103
5.15.26.05	Gerrha	Jayrud	32.83	70.00	33.8057	36.7400
5.15.26.07	Nelaxa	Najran	32.50	70.17	32.8458	36.4471
5.15.27.02	Arados I.	Ruad I.	34.50	68.00	34.8558	35.8584
5.15.27.03	Tyros I.	Tyre	33.33	67.00	33.2693	35.1959

Table 3. Modern coordinates for known locations in Mesopotamia (Book 5 Chapter 18).

Ptolemy ID	*Ptolemy Name*	*Modern Name*	*Ptol. Lat.*	*Ptol. Lon.*	*Mod. Lat.*	*Mod. Lon.*
5.18.02.02	Masion Mtns (middle)	Tur Abdin Mtns	37.33	74.00	37.7117	39.8283
5.18.02.03	Singaras Mtns	Jabal Sinjār	36.25	76.67	36.3553	41.7543
5.18.03.01	Chaboras R. sources	near Kamerseki Tepesi M.	37.25	74.00	37.5704	39.8754
5.18.03.02	Chaboras R. joins Euphrates	Khabur R.	35.00	74.00	35.1260	40.4270
5.18.05.03	Porsica	Birecik	37.50	72.00	37.0320	37.9798
5.18.05.07	Bersiba	Tall Aḫmar	35.58	72.33	36.6747	38.1193
5.18.06.01	Nicephorium	Ar Raqqah	35.33	73.08	35.9572	39.0469
5.18.06.05	Apphadana	Al Faydan	34.58	74.50	35.3634	40.5623
5.18.07.01	Agamana	Anah	33.50	76.50	34.3719	42.0349
5.18.07.02	Eudrapa	Qal'at es-Salihiye (Dura Europos)	33.67	77.17	34.7483	40.7298
5.18.07.03	Addaea	Haditha	34.00	77.25	34.1377	42.3787
5.18.07.06	Naarda	Nehardea	35.50	77.67	33.3788	43.7150
5.18.07.07	Sipphara	Sippar	35.67	78.25	33.0588	44.2522
5.18.08.01	Euphrates splitting		35.67	79.00	32.7308	44.2682
5.18.08.03	Seleucia	Seleucia	35.67	79.33	33.1337	44.5175
5.18.09.05	Singara	Sinjar	37.00	76.00	36.3213	41.8626
5.18.09.09	Carthara	Hatra	36.25	79.00	35.5881	42.7178
5.18.10.01	Bithias	Bozova	37.67	72.33	37.3609	38.5231
5.18.10.02	Edessa	Şanlıurfa	37.50	72.50	37.1456	38.7843
5.18.10.04	Ammaea	Amuda	37.83	73.33	37.1042	40.9293
5.18.10.06	Rhisina	Tell Fecheriye	37.50	73.50	36.8419	40.0701
5.18.10.07	Olibera	Büyüktoklu	37.00	73.50	37.2606	39.2935
5.18.10.08	Sararra	Gürkaynak	38.25	74.00	37.1119	41.6275
5.18.11.01	Arxama	Harzem	37.25	74.67	37.2480	40.6281
5.18.11.02	Gizama	Tel Halaf	37.25	74.33	36.8266	40.0396
5.18.11.05	Nisibis	Nusaybin	37.50	75.17	37.0642	41.2173
5.18.12.01	Carrae	Harran	36.17	73.25	36.8647	39.0312
5.18.12.03	Thengubis	Tall Taynīz	36.50	74.67	36.4212	40.8667
5.18.12.05	Eleia	As Sukaynīyah	36.75	74.67	36.3081	41.5600

Table 4. Modern coordinates for known locations in Babylonia (Book 5 Chapter 20).

Ptolemy ID	*Ptolemy Name*	*Modern Name*	*Ptol. Lat.*	*Ptol. Lon.*	*Mod. Lat.*	*Mod. Lon.*
5.20.04.04	Bible	Dilbat	34.00	79.00	32.2957	44.4683
5.20.05.02	Tigris R. mouth (eastern)	Shatt al-Arab	31.00	80.50	29.9277	48.6123
5.20.05.03	Tigris R. mouth (western)	Khawr Abd Allah	30.25	79.50	29.8764	48.3826
5.20.06.02	Idicara	Hit	33.33	77.00	33.6404	42.8313
5.20.06.07	Babylon	Babylon (former Tell Babil)	35.00	79.00	32.5420	44.4212
5.20.06.10	Borsippa	Borsippa	34.33	78.75	32.3917	44.3413
5.20.07.05	Chumana	Umma	33.17	79.00	31.6213	45.9334
5.20.07.08	Orchoe	Uruk	32.67	78.50	31.3233	45.6366