FAIR Turn in Epigraphy: Low Barrier Pathways to Quantitative and Reproducible Research in Latin Epigraphy

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Abstract

The application of FAIR (Findable, Accessible, Interoperable, Reusable) principles can revolutionise the epigraphic discipline by facilitating quantitative and reproducible research. Despite the richness of Latin inscriptions, the lack of low-barrier tools for accessing and analysing these datasets has hindered large-scale studies and the uptake of FAIR and Open Science principles in ancient studies. The *LatEpig* v2.0 tool addresses this gap by enabling researchers to programmatically access the *Epigraphic Database Clauss-Slaby*, and generate reproducible research following state-of-the-art standards. The main aim of *LatEpig* is to democratise data access and enhance research potential without requiring advanced technical skills. A case study on 'viator' inscriptions exemplifies the tool's utility, illustrating spatial and temporal trends in inscriptions addressing messengers and travellers across the Roman Empire. *LatEpig* exemplifies that the development of similar tools is crucial for advancing FAIR and Open Science practices in the Humanities, ensuring that substantial investments in digital resources are fully realised.

Keywords

Roman Empire, Latin inscriptions, quantitative epigraphy, research software development, ancient history

1. Introduction

Over the past 40 years, the digitisation and development of the *Epigraphic Database Clauss-Slaby* (EDCS), has made 539,766 Latin inscriptions accessible online.[1] EDCS represents one of the richest resources to study the development of the Roman Empire (27 BCE - 476 CE in the West / 1453 CE in the East) and its inhabitants. Inscriptions - short messages written on durable materials, range from funerary markers and epitaphs, dedications, public decrees and

[1]Accessed 15 June 2024.

accounts, milestones and boundary markers, to curse tablets and magic formulae [8]. They offer insights into broad phenomena, such as migration and mobility [38, 25], diffusion of religious beliefs [11], economic performance and specialisation [40, 21], commemoration practices [3, 4, 28] but also linguistic variation and social change [26, 34], covering the Mediterranean over several centuries[16].

Despite being an invaluable resource for Latin epigraphy, EDCS has significant issues that hinder its full potential for quantitative studies [16]. Problems such as unclear attribution of individual text editions and uncertain authorship of editorial changes limit the impact of the extensive effort and investment in developing this rich resource [9, 31, 5]. The data in EDCS is **findable** and **accessible for viewing** via a simple web interface, which allows searches based on various criteria, such as free text within inscriptions, metadata like date or origin, and preselected keywords related to socio-political status or typology of inscriptions. However, the search results are displayed as ephemeral HTML outputs without options to download or save parameters, making **reuse** and replication impossible. Moreover, hidden in the plain sight of the search output, important information, like geographical coordinates and links to other databases, is difficult to access and can be achieved through a series of clicks. Manual data extraction is tedious and error-prone, further contributing to the lack of **interoperability** and overall unFAIRness of EDCS [16].

In an attempt to solve the known limitations of EDCS, we came up with a low-threshold solution that allows researchers or students of ancient history to access and utilise the EDCS in a reproducible manner and enables large-scale longitudinal studies of Latin epigraphy, while adhering to the standards of FAIR and Open Science [39]. While developing an application programming interface (API) would solve the issue for programmers and more advanced users, the majority of researchers and students in ancient history and related fields do not have the necessary skill set or resources to hire IT personnel to query an API. This was demonstrated by the case of *LatEpig* version 1.0, which was a simple command-line tool, that however proved to be too complex for the target audience. Thus, we decided to create a tool that allows for novice-user-friendly access to the data, while adhering to the highest standards of Open Science.

The value of *LatEpig* as a research tool is evident in the numerous projects that have utilised it since its release in 2021 [2]. Researchers have used *LatEpig* to access and process all EDCS inscriptions, enriching them for quantitative studies [13, 14, 16]. Machine-learning classification of inscription types, as conducted by [20], expanded the dataset into *Latin Inscriptions in Space and Time* (LIST, [22]) and *Latin Inscriptions of the Roman Empire* (LIRE, [23]). These authors also addressed biases and temporal uncertainty in epigraphic datasets [16]. Other studies leveraged the expanded LIST and LIRE datasets to explore topics such as the popularity of the healing deity Asclepius during the Antonine Plague [11] and the economic specialisation in the Roman Empire [21]. The Minerva project developed *Itiner-e: The Gazetteer of Ancient Roads*, using milestones to trace Roman roads [7]. Additionally, *LatEpig* was employed to train neural networks for reconstructing missing text within inscriptions, opening new avenues for large language models in epigraphy [30].

As a practical example of *LatEpig*'s contribution to the current research agendas, we present a case study of 'viator' inscriptions - texts placed along Roman roads addressing passers-by, documenting not only the mobility of people but also suggesting the relatively widespread literacy levels. While 'viator' inscriptions are a well-known phenomenon, their exact extent and

historical development remain unexplored. We will demonstrate how *LatEpig* can contribute to the broader understanding of this phenomenon while adhering to FAIR and Open Science principles. We publish all steps in the case study R script along with detailed comments and provide interested scholars and students with a step-by-step script, guiding them through a simple analysis of several hundred inscriptions.

2. How to FAIRify Latin inscription in a few clicks

The *LatEpig*'s main purpose is to alleviate some of the technological and methodological inefficiencies of EDCS and enable reproducible and quantitative research of Latin inscriptions to anyone, without requiring any special programming skills. The novice user can run *LatEpig* with a single click in a myBinder Jupyter Notebook web interface, with instructions directly available in the Notebook with examples of possible searches. Once users are happy with the parameters and results of their search, they can download them as JSON or TSV files to their computer, with the search metadata written directly to the file name for ease of replication and verification. The downloaded file contains 22 attributes, such as the text of the inscription, dating, place name, latitude and longitude etc. As an addition to EDCS, cleaned text of the inscription is available in three different formats, suitable for distant reading methods and NLP. For details, see the *LatEpig* output metadata description.

Users wishing to explore the spatial aspect of the results can display the search output on an interactive map (Figures 1 and 2), allowing visual inspection of the results along with the system of Roman Provinces and road network. Alternatively, upon zooming in the map they can open a detailed record of individual inscriptions, dynamically populated from the selected search output.

Some users might be interested in publishing the search results on a map without having to export data to a separate GIS software while maintaining the principles of FAIR and Open Science. For this purpose, *LatEpig* contains a separate (experimental) interface, that allows publishing *LatEpig* search results as a high-quality map with customisable parameters (BW or colour, DPI values, output file type, add/remove open historical geospatial layers). For better reproducibility and transparency of the research output, the search parameters and other metadata (source, tool used, date, number of results, map parameters) along with their licenses and credits, are printed on the map and to the filename, see Figure 3. When creating a map with the results of the custom search, users can select layers to include in the map, such as the boundaries and provinces of the Roman Empire at different points in time [17], Roman roads [32], and ancient cities [12].

3. Case study: the 'viator' inscriptions

The 'viator' inscriptions are part of the broader phenomenon of 'speaking stones', inanimate objects that address anonymous passers-by. These epitaphs invite people to read, reflect and commiserate the fate of the deceased [1] Found in both Latin and Greek during the first four centuries CE, when the Mediterranean region was under Roman control, see Figure 3, they are often cited as evidence of high literacy, as random travellers were expected to read them
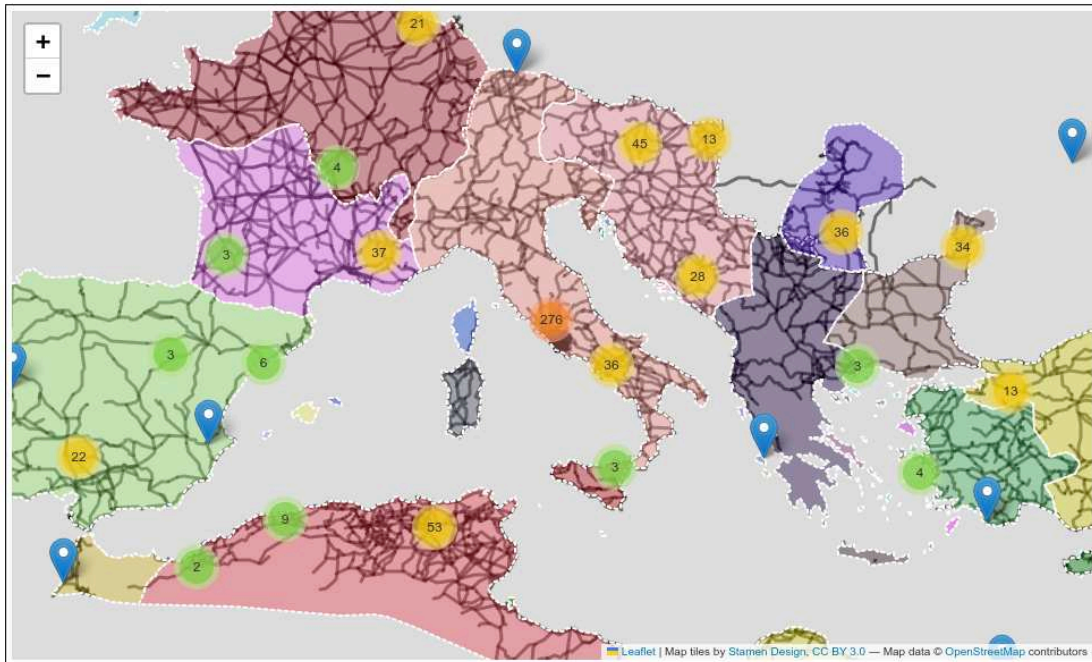
651

Interactive Map

Update Data File List

Data File 2024-06-14-EDCS_via_Lat_Epig-term1_viator-697.tsv ▾

Refresh Interactive Map!

Interactive Map Output

Figure 1: *LatEpig* Interactive map of Roman Empire displaying the result of the search 'viator', N=697 inscriptions.

while pausing their travels. Typically located on funerary inscriptions along roads leading to settlements [27], 'viator' inscriptions are considered widespread, yet there is a significant lack of quantitative studies offering a comprehensive view of their distribution and extent of the phenomenon.

According to Lewis and Short's classical dictionary, the noun viator, oris, m. has two meanings: broadly, a 'wayfarer' or 'traveller', and more narrowly, an 'apparitor', an officer who summoned people before the magistrate [29]. The Oxford Latin Dictionary also defines 'viator' as either a traveller or, in the epigraphic context, the addressee of roadside inscriptions, as well as an official messenger employed by Roman magistrates, colleges, or public bodies[10].

3.1. Results

We extracted the occurrences of the term 'viator' in Latin texts from EDCS using the *LatEpig* tool, which resulted in 697 hits, see raw data on GitHub. Out of the 697 inscriptions containing
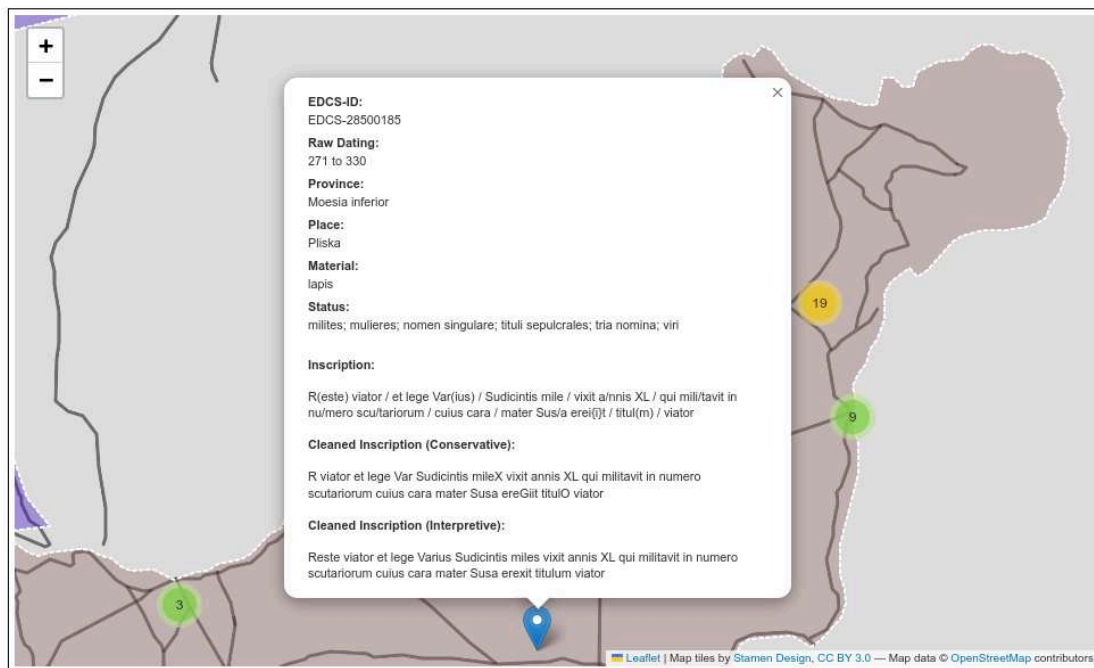
Interactive Map

Update Data File List

Data File 2024-06-14-EDCS_via_Lat_Epig-term1_viator-697.tsv ▾

Refresh Interactive Map!

Interactive Map Output

Figure 2: *LatEpig* Interactive map with a detailed overview of the inscription EDCS-28500185 dated between 271 and 330 CE from Pliska in Moesia Inferior (modern-day Bulgaria). The text of the inscriptions invokes the passer-by to stop and read (reste viator et lege) about the life of Varius Sudicintis, a soldier who died at age 40, and his dear mother who Susa commissioned the inscription. Other online sources, however, provide a variant reading: instead of Varius Sudicintis, the deceased was named Varsudicintis, see https://edh.ub.uni-heidelberg.de/edh/inschrift/HD042071.

the search term *viator*, the largest group consists of epitaphs (*tituli sepulcrales*), representing 46.7%, followed by inscriptions of unknown type at 16%, religious inscriptions (*tituli sacri*) at 11.5%, and building inscriptions (*tituli operum*) at 11.4%. The interpretively refined version of the text identified 347 instances of the personal name *Viator* with a capitalised 'V' and 350 instances of the noun *viator* in lowercase.

Upon closer inspection, many of these were instances of the personal name 'Viator', rather than the noun 'viator'. Focusing on the 350 instances of the noun 'viator', 51.2 % are epitaphs, 17 % unknown type, 15.9 % building inscriptions, and 7.5 % are religious inscriptions. Through a combination of distant and close reading of the 226 epitaphs, we have identified the following patterns:

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The 'viator' inscriptions

Legend:
- Roads
- Cities
- Inscriptions

1000 km

N
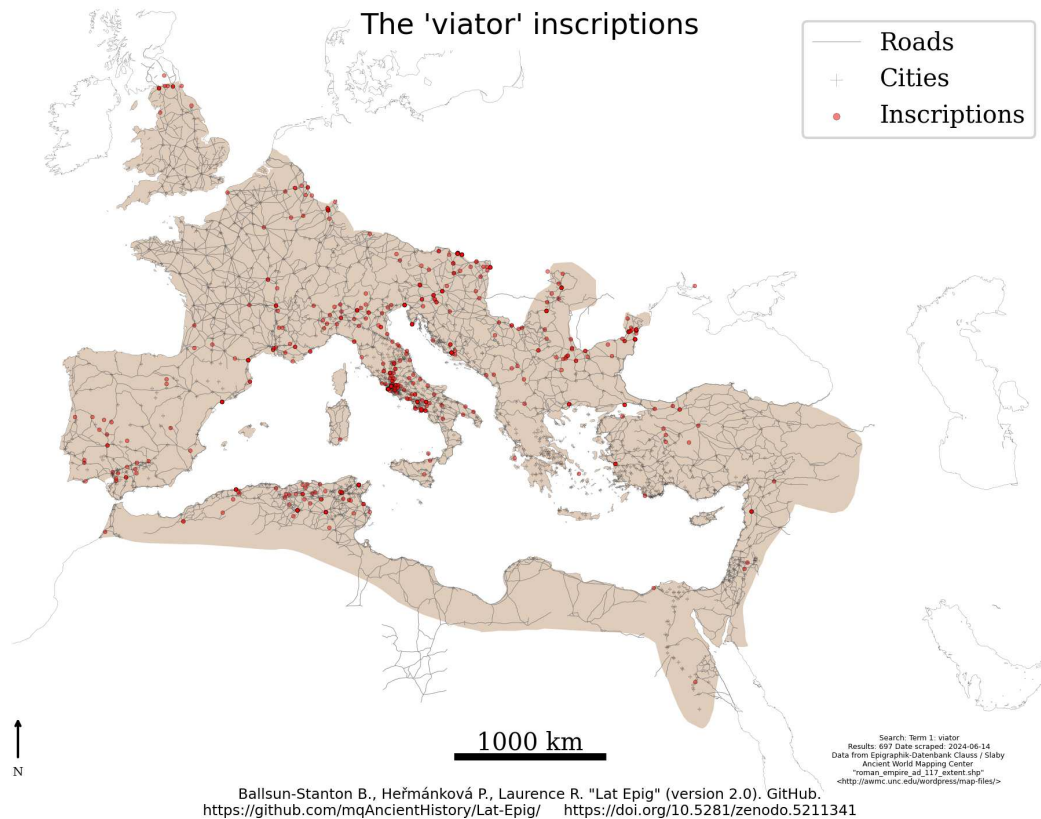
Figure 3: Publication-ready map displaying the result of the search 'viator', N=697, with roads and cities, the borders of the Roman Empire in AD 117. The search parameters are automatically printed on the map, along with the data sources used for the map.

1. The noun *viator*, meaning 'passer-by' or 'unknown traveller,' is frequently used in exhortations to pause and reflect on the deceased. Common verbs in the imperative include *reste* (stop, pause), *siste* (stop), *consiste* (stop, stand still), *ave* (hail, farewell), *vale* (farewell, be well), *scire* (know), *cognosce* (learn), as well as the first-person singular *rogo te* (I ask you), or the plural imperative *avete vos viatores* (farewell, travellers). This usage accounts for 72.6% of the *viator* occurrences in the 226 epitaphs.

2. The noun *viator* also appears in the context of an attendant to a low-ranking Roman official, often mentioned as part of the *cursus honorum* (list of achievements) of the individual in the inscription. Examples include *viator tribunicius*, *viator consulum/consularis*, *viator quaestorius*, *viatori apparitori*, *viatores collegii*, and *decurialis viatoris*. This group represents 24.8% of the *viator* occurrences in the 226 epitaphs.

3. In 2.6% of the *viator* occurrences, the meaning remains uncertain due to fragmentary preservation of the text.

For the temporal distribution of the three contextual groups, dating intervals were available for 174 inscriptions. To address temporal uncertainty in the epigraphic data, we applied Monte
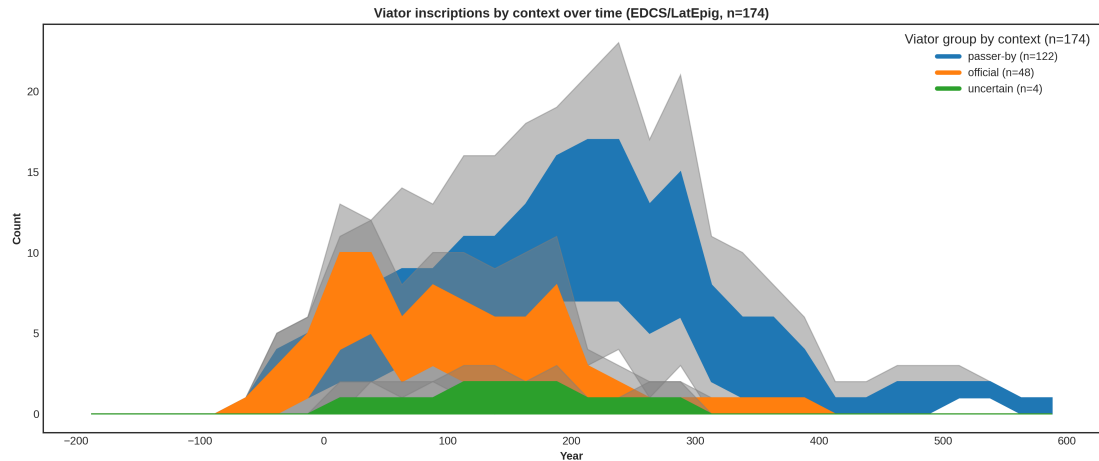
Figure 4: Temporal distribution of dated epitaphs mentioning the noun 'viator' by its context, N=174. We can see two distinct temporal patterns: the popularity of the attendant to Roman officials (in orange) on inscriptions precedes the one referring to travellers (in blue). The trends represent a result of a Monte Carlo simulation applied to mitigate for relatively high-level of temporal uncertainty of inscriptions. The data's confidence interval visually represents the uncertainty level for a given point in time (in grey).

Carlo modelling methods [24], generating 1000 dataset variants based on the widest dating intervals and plotting them with confidence intervals (shown in grey). Figure 4 reveals distinct trends: inscriptions mentioning attendants to low-ranking officers peaked during the Julio-Claudian dynasty (1st-2nd centuries CE), declining after 200 CE and disappearing by 400 CE. Inscriptions addressing travellers were most frequent from the late 2nd century CE until 300 CE, after which their numbers declined but persisted in small numbers until 600 CE.

To explore spatial trends, we plotted the contextual groups on a map of the Roman Empire across eight historical periods using Monte Carlo methods. The results in Fig 5 show two distinct trends: The results show two distinct trends: a) inscriptions referring to low-ranking officials are concentrated around Rome throughout all periods, and b) inscriptions addressing passers-by are more geographically dispersed, appearing in both the West and East. Due to its population density and road networks, they cluster in Italy, and also in Moesia Inferior along the northeastern border. A similar trend addressing travellers was also observed in bilingual and Greek inscriptions, using phrases like χαῖρε παροδεῖτα (i.e. EDCS-27800442 from the 4th century CE Constanta / Tomi in modern-day Romania).

The rise of 'viators' as the attendants to Roman officials coincided with the growth of the state apparatus during the Julio-Claudian period, particularly under Emperor Augustus (27 BCE - 14 CE). This era saw an increase in epigraphic production in general and tendencies to elevate one's social status [6, 35]. The decline after 200 CE might be explained by a shift in societal values, leading to the prestige deterioration of state servants, or by an unknown regulation, that limited the practice.

The occurrence of 'viators' as travellers aligns with the development of the Roman road network and the overall patterns of epigraphic production [16], peaking in the late second century

CE and declining by the third. However, they remained common until 300 CE, particularly in Moesia Inferior and Superior, where nearly half were linked to soldiers or veterans. Nearly half of the inscriptions from Moesia Inferior (18 out of 38) were dedicated by/to a soldier or a veteran, indicating the strong influence of the Roman military on the epigraphic production along the northeastern border of the Empire. Future research should analyse Greek inscriptions to better understand why 'viator' inscriptions were especially popular among soldiers in Moesia compared to other border provinces.

The 697 instances of the term 'viator' in EDCS challenge the notion of widespread diffusion of these inscriptions. While EDCS does not include every Latin inscription, its broad and consistent spatial coverage makes it unlikely that many 'viator' inscriptions are missing. Based on the data extracted from EDCS, *LatEpig*, we have learnt that the phenomenon is less common than portrayed in reference books and publications, which often highlight specific examples rather than providing a comprehensive overview. Using *LatEpig*, we were able to perform the analysis in a substantially shorter time and in a fully reproducible manner, providing the data and scripts for reevaluation.

4. Discussion

Most epigraphic databases were designed well before the FAIR and Open Science movement was formulated and introduced to the Humanities. In cases, where their original data structure and its implementation are not up to par with FAIR principles, the development of tools enabling low-threshold access and reuse plays a key role. The *LatEpig* successfully fills the gap between the data and the needs of the researchers, wishing to explore new dimensions, equipped with research questions that go beyond a single data point, or even beyond 10,000 of them. It needs to be reiterated that *LatEpig* does not intend to create new data, but to democratise the existing ones by providing easier access and introducing scale and transparency to epigraphic research while giving full credit to the EDCS creators. We do not claim to fix all known issues with the contents of the EDCS, such as unclear attribution of text editions or authorship of the records. Instead, we focus on ensuring the output is stable and transparent, which leads to higher reproducibility of epigraphic research. What once started as a side-fun-job, has grown into a mature tool with several success stories, precisely because of the demand from the community, riding on the waves of FAIRification.

We would, of course, prefer there to be no need for a 'scraper' in the first place. Tools that rely on parsing the HTML output of a website are notoriously fragile, and our scraper had to be modified several times to reflect upstream changes by the database maintainers [33]. On the other hand, the democratic accessibility of this tool does not require the database authors to apply for more funding or to engage in a development effort they may not have time or attention for, such as an API. These ad hoc tools also form part of the academic's toolkit, even if they are fragile by nature. A secondary benefit of our scraper is the ability to preserve the database in TSV and JSON files in case of sudden loss of original data and disappearance of the site. Still, tools like ours form an intermediate phase between early-web projects and those built on the standards of a FAIR and open scholastic and semantic web [18].

The FAIR turn in epigraphy is a relatively recent phenomenon, yet much needed [15, 5].

A substantial investment was made in creating digital resources, and yet, the reuse of digital datasets in the Humanities lags [37, 19, 36]. Building low-barrier tools such as *LatEpig* may help alleviate the disconnect between data creators and data users until there is a better uptake and internalisation of the FAIR principles by the data creators in the research community.

Acknowledgments

A. Online Resources

The one-click *LatEpig* tool is available via MyBinder online service. *LatEpig* sourcecode is available on PyPi, GitHub and Zenodo.

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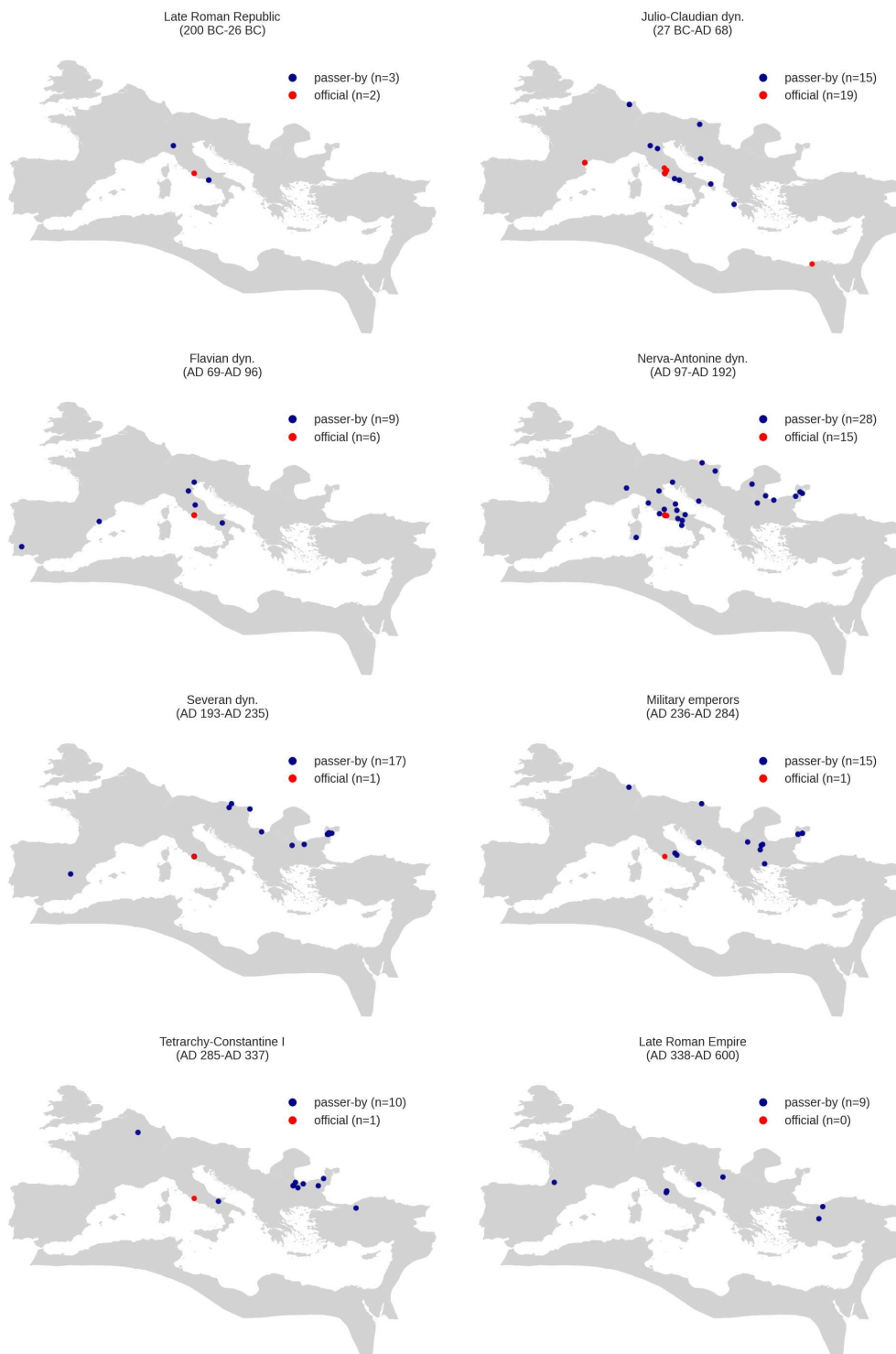
Figure 5: Spatial distribution of epitaphs mentioning the noun 'viator' by its context. The dots represent findspots of inscriptions, placed within the borders of the Roman Empire in 117 CE. The dated inscriptions (N=174) are modelled using the Monte Carlo simulation, which creates a random date within their dating interval and then groups them in one of the eight historical periods, shown as individual maps.