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Combined Approach to Locate Medieval Fortified Manor Houses in Central Moravia (the Czech Republic)

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ABSTRACT

A systematic prospection of medieval fortified manor houses (FMHs) in Central Moravia (Czech Republic) was conducted with the aim of mapping their distribution and facilitating both further scholarly research and more effective heritage protection by responsible institutions. Given the inherent limitations of individual investigative techniques, a combined methodological framework drawing on historical research, socio-historical approaches and natural-science methods was employed. This integrated approach proved effective: of the 123 initially presumed FMHs, 79 were confirmed as having medieval origins, while the remaining 44 sites were shown to be of later date, of uncertain chronology or unfortified. Remote sensing verified a substantial proportion of FMHs recorded in historical sources; however, archaeological research, fieldwalking survey, geophysical survey and the analysis of historical maps also yielded valuable results. The spatial distribution of Central Moravian FMHs, comparable with that of fortified manorial residences elsewhere in Central Europe, reflects their multifunctional character but is primarily conditioned by agricultural suitability, particularly the presence of fertile soils, as well as by territorial constraints imposed by major landholders such as margraves and bishops.

1 | Introduction

One of the persistent challenges in cultural heritage management in Central Europe is the limited visibility, documentation and public presentation of small medieval fortifications. In contrast to large medieval stone castles—many of which were reconstructed during the nineteenth and twentieth centuries and are now protected as designated cultural monuments—these minor fortified sites have attracted comparatively little scholarly and conservation attention. Fortified Manor Houses (FMHs), also encompassing small castles, functioned as noble residences in the West Slavic regions between the thirteenth and fifteenth centuries AD (Úlovec et al. 1998–2005; Schütz 2011; Drnovský 2022). The precise definition of FMH remains ambiguous; however, the term generally refers to an enclosed and

restricted area containing a central residential building and/or tower, with the internal space structured into distinct functional components (Novák 2019). FMHs were smaller and less luxurious than castles but also fulfilled defensive, economic (centres of trade and fee collection), storage and symbolic functions; however, in the case of smaller FMHs, their sphere of control was typically limited to the immediately surrounding area (Schütz 2011). Following the loss of their defensive role—often by the late Middle Ages in connection with the spread of firearms—many were subsequently overbuilt by later constructions or levelled to the present-day terrain.

The aim of our research, conducted from 2024, was to identify the remains of such fortifications in Central Moravia (the Czech Republic) and make the results broadly available online

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for the purposes of Cultural Heritage Management. When identifying FMHs in the field, we soon realized the limitations of relying on a single prospection or identification method. The locations of the manors are nowadays often hard to access due to forest cover, or owned by private persons or companies, so that, e.g., geophysical measurement is not always possible. We therefore decided to apply a combination of methods through collaboration among historians, archaeologists, geographers and geophysicists to enable the identification of fortified manors. It transpired that the study of historical documents, plans and maps should constitute the primary (and often the only possible) phase of research when identifying cultural monuments. Fieldwalking- and geophysical survey, and archaeological excavation, are best applied afterwards to support the results of the primary phase.

The identification of FMHs serves multiple research and heritage-management objectives. It enables historians and archaeologists to analyse their spatial relationships within the landscape, including intervisibility, control over communication routes, waterways and mining areas, and to assess diachronic changes in their location and function throughout the Middle Ages. At the same time, such identification provides an essential foundation for the protection of these sites against potential degradation or destruction caused by natural and anthropogenic factors, including flooding, erosion, urban expansion, fire, looting and the development of modern infrastructure. Comparable assessments of medieval FMHs have been undertaken in Great Britain (Davis 2017) and China (Yang et al. 2023). While regional and chronological contexts differ, the methodological principles employed are largely analogous and broadly applicable to the protection and management of cultural heritage sites of any period (Nicu 2016; Hammer et al. 2018; Bosher et al. 2020).

Systematic scholarly research on medieval castles and fortified manors in the Czech Republic (formerly Czechoslovakia) began to develop only in the second half of the twentieth century (Menclová 1972; Durdík 1984). Following a period characterised by largely descriptive and methodologically limited works (Hosák and Zemek 1981), more rigorous and analytically grounded studies of medieval aristocratic residences in Bohemia, Moravia and Silesia emerged from the 1990s onward (Durdík 1995, 1999; Plaček 1996, 2001), building upon research initiatives undertaken during the late socialist period. Parallel research efforts were conducted and published by multiple authors (Měřínský 1981; Nekuda and Unger 1981; Musil 1998, 2001, 2002; Úlovec et al. 1998–2005; Kouřil et al. 2000). Despite this general development, Central Moravia has not yet been the subject of a comprehensive castle-studies synthesis, including its main agglomeration, Olomouc (Pinkava 1927; Tymonová 1996). Overall, the area remains understudied, and archaeological collections from more than 80 FMHs housed in the Archaeological Department of the Regional Museum in Olomouc have received only minimal archaeological attention. Aside from chance finds, most artefacts originate from excavations whose results were typically only briefly presented in popular-science publications, while comprehensive site publications remain rare (Vrána and Vránová 2005). Systematic attention has primarily been

devoted to ‘active’ heritage sites under the administration of the National Heritage Institute, such as Bouzov and Šternberk castles. Technological developments and interdisciplinary collaboration have enabled advanced 3D documentation (digitalisation, laser-scanning) and the visualization of historical architecture only during the 2010s.

2 | Methods

The methodological framework applied in this study is described in detail below, with individual research methods presented in separate subsections; an overview of all methods and their respective roles in the identification and verification of FMHs is subsequently summarised in Table 1 and Supporting Information S2. Part of Supporting Information S1 (excluding the inserted map) was prepared with the assistance of artificial intelligence (ChatGPT-5.5).

For each site, individual research steps were recorded in a binary format (YES/NO; Supporting Information S2) to indicate whether each type of investigation was conducted. These steps comprise desk-based historical research, historical mapping (HM) analysis, remote sensing, fieldwalking survey, archaeological investigation (excavation and/or historical building survey) and non-destructive geophysical survey (Table 1, Supporting Information S2, and the online map: <https://mujdu.mmujhrad.upol.cz/verification/>). For those research categories where field-based or analytical investigation was carried out, the outcome was further evaluated as either positive or negative. A positive result indicates that structural remains, spatial features or material evidence were identified that can be reliably dated to before AD 1500, while a negative result denotes either the absence of detectable remains or the presence of features that are assumed or known to post-date this threshold. The AD 1500 limit was adopted as a practical chronological boundary separating medieval fortified residences from Early Modern constructions.

Chronological attribution (‘Dating’ in Supporting Information S2) is based on a critical synthesis of all available evidence, including written historical sources, archaeological data, architectural observations and results of non-invasive surveys. The column ‘Historical’ (Supporting Information S2) records the earliest written mention of each site in historical documents. Geographic location is expressed in the WGS 84 coordinate system, with an additional five-level classification reflecting the ‘Location precision’. Category 1 includes sites precisely localised within the framework of the present project through field verification or combined analytical methods. Category 2 comprises sites previously known and precisely localised based on earlier archaeological, historical or heritage documentation. Category 3 denotes sites approximately localised within the present project, where only an estimated position of the FMH could be established. Category 4 includes approximately localised sites known from earlier literature or historical evidence but lacking precise spatial verification. Category 5 represents sites of unknown location, where coordinates correspond only to the centre of the respective municipality or cadastral unit.

TABLE 1 | Different stages of FMH research and their respective outputs. HBS = Historical building survey.

Category	Description/ possible values	Methods	Description/possible values
Historical research	YES (conducted)/NO (not conducted)	Historical (written sources) Dating	First written mention of the site in historical documents Chronological attribution based on the analysis of historical, archaeological, and other relevant sources
Historical mapping	YES (conducted)/NO (not conducted)	HM—results	Positive—remains recorded that can be dated to before AD 1500 Negative—no remains recorded, or remains are assumed or known to post-date AD 1500 Unknown—not applied
Remote sensing	YES (conducted)/NO (not conducted)	RS—results	Positive—remains recorded that can be dated to before AD 1500 Negative—no remains recorded, or remains are assumed or known to post-date AD 1500 Unknown—not applied
Fieldwalking survey	YES (conducted)/NO (not conducted)	FS—results	Positive—remains recorded that can be dated to before AD 1500 Negative—no remains recorded, or remains are assumed or known to post-date AD 1500 Unknown—not applied
Archaeology (Excavation + HBS)	YES (conducted)/NO (not conducted)	Archaeology—results	Positive—remains recorded that can be dated to before AD 1500 Negative—no remains recorded, or remains are assumed or known to post-date AD 1500 Unknown—not applied
Geophysics	YES (conducted)/NO (not conducted)	Geophysics—results	Positive—remains recorded that can be dated to before AD 1500, with specification of applied method (abbreviation) Negative—no remains recorded, or remains are assumed or known to post-date AD 1500 Unknown—not applied
Precise location (WGS 84)	Geographic coordinates derived from cartographic sources	Location precision	1—precise, determined within the project 2—precise 3—approximate, determined within the project 4—approximate 5—unknown (coordinates correspond to the centre of the municipality)

This structured approach allows for a transparent comparison of sites investigated using different combinations of sources and methods and provides a consistent framework for assessing the reliability of individual identifications across the study area. To ensure methodological consistency, a site was classified as 'Positive' (Supporting Information S2; https://docs.google.com/spreadsheets/d/1ZMh5GRVHtmYq_mUZmpSke6lupfV3

[uM7LZgUIMu0zfpI/edit?pli=1&gid=0#gid=0](https://docs.google.com/spreadsheets/d/1ZMh5GRVHtmYq_mUZmpSke6lupfV3)—spreadsheet linked to the map at <https://mujdummujhrad.upol.cz/verification/>) only when the respective line of evidence provided a credible indication of a medieval fortified noble residence dated before AD 1500. The operational criteria for a positive classification differed according to the applied method and are summarised below.

2.1 | HM—Positive

Cartographic depiction of earthworks, enclosures, ditches, platforms or ruin symbols that are plausibly medieval and not demonstrably early modern or modern.

2.2 | Remote Sensing—Positive

LiDAR- or aerial-image-derived terrain anomalies consistent with fortified architecture (e.g., ditched enclosures, ramparts, rectilinear platforms), without indications of later disturbance or post-medieval origin.

2.3 | Fieldwalking Survey—Positive

Surface-visible features and/or diagnostic artefacts (e.g., medieval ceramics, building debris) spatially consistent with a fortified residence.

2.4 | Archaeology (Excavation and/or HBS)—Positive

Archaeological or architectural evidence documenting masonry, defensive features or building phases attributable to a fortified noble residence dated before AD 1500.

2.5 | Geophysics—Positive

Subsurface anomalies consistent with masonry or fortification elements (e.g., walls, enclosed compounds, moats), interpreted in conjunction with site context and corroborating evidence.

A 'Negative' classification indicates either the absence of relevant features or the presence of structures demonstrably younger than AD 1500.

2.6 | Historical Methods

Most FMHs were mentioned in historical documents ('Historical Research' in Table 1; [Supporting Information](#)) like Zemské desky ('Land Tables'; preserved since 1348 in Moravia), *urbaria* and diplomatic records (e.g., charters or letters), stored in various archives throughout the Czech Republic, many of which were published in editions of sources. In total, 123 potential FMHs were identified in historical sources from Central Moravia, mostly based on the existence of a nobiliary particle (*praedicatum*). These were further checked by both historical and other methods to corroborate or disprove their medieval origin. Courtyards (*curiae*) were excluded from our dataset, as they primarily served economic functions and typically lacked substantial fortifications. Although earlier sources sometimes use *curia* to denote a fortified residence (*dvorec*), after ca. AD 1300, the period to which most of the studied structures belong, the term generally referred to economically oriented complexes. Fortified structures in contemporary Latin sources were more commonly described

as *munitio* (fortified manor house) or *castrum* (castle). Data collection therefore followed the terminology used in contemporary sources, while acknowledging ambiguities in vernacular languages (Czech and German), particularly terms such as *zámek* or *Schloss*, which require contextual interpretation based on function, ownership and local naming traditions. The term residence was deliberately avoided due to its shifting meaning over time. Instead, manor house is used, as it more accurately reflects the functional variability and defensive role of the studied objects. Historical names of FMHs, which may differ from the contemporary cadastral names used in this study, are also provided in Supporting Information S2 (column U). Historical research also included the study of historical maps (HM). The most complete historical maps of the Bohemian and Moravian lands come from the first and second military Land Survey, realized between 1764–1768 (rectified between 1780 and 1783) and 1836–1852, respectively (chartae-antiquae 2025). These often depict medieval fortifications or their remains (even those which have not been preserved to the present day) with varying degrees of precision.

2.7 | Remote Sensing

FMHs could often be identified through remote sensing ('Remote sensing' = RS) using LiDAR (Light Detection and Ranging). LiDAR is a laser-based distance-measurement technology that enables high-resolution three-dimensional modelling of terrain and surface objects by measuring the time interval between laser pulse emission and signal return (Sittler and Schellberg 2006; Bofinger 2007; Doneus et al. 2008; Lasaponara et al. 2011; Gojda et al. 2011; Bollandsås et al. 2012; Gojda et al. 2013). In this study, LiDAR data were acquired using airborne laser scanning (ALS) from both manned aircraft and UAV platforms, covering an area of approximately 5300 km² (Martínek et al. 2013; Martínek et al. 2014; Martínek 2019).

The physical principle of ALS is based on the precise measurement of the time interval between the emission of a laser pulse and the detection of its reflection by the receiving sensor. The distance between the sensor and the reflecting object is subsequently determined as the product of the speed of light and the measured signal travel time (Watkins 2005). Laser pulses are emitted at a very high repetition frequency, typically ranging between 80 and 400 kHz, corresponding to tens to hundreds of thousands of individual measurements per second. For accurate spatial localization of the reflection point, it is necessary to determine both the temporal parameters and the exact position and orientation of the scanning unit at the moment of pulse emission. The absolute position of the scanner is determined using an onboard differential GPS (DGPS) system within the WGS-84 reference coordinate framework, while its spatial orientation (including pitch, roll and yaw deviations from the flight axis) is continuously monitored by an inertial measurement unit (IMU) rigidly integrated with the scanner (Šíma 2009).

The sites discussed in this study and their immediate surroundings were surveyed using a Riegl LMS-Q680i airborne laser scanner along predefined flight strips at an altitude

of approximately 600–900 m above ground level. This corresponded to swath widths ranging from approximately 700 to 1000 m and a measurement density of 3–5 laser points per m².

The RS output consisted of a three-dimensional point cloud representing terrain and object reflections. For most archaeological landscape features, a point density of approximately 3–4 points per square metre was sufficient to identify a wide range of anthropogenic and natural forms, including fortifications. The point clouds were subsequently interpolated into raster digital terrain models (DTMs), for which a spatial resolution of 1 m is recommended. A hillshade raster was subsequently generated using the Horn algorithm with the following parameters: solar azimuth 315°, solar elevation angle 30° and a Z-factor (vertical exaggeration) of 5. The raster was processed in PhotoFiltre Studio, where histogram adjustment, noise reduction and partial image smoothing were applied.

2.8 | Fieldwalking Survey

Some sites were prospected through fieldwalking archaeological survey ('Fieldwalking Survey'), whose main aim was to identify terrain relics of medieval fortifications. In some cases (e.g., FMH at Lysov [locality 50]), it was accompanied by sampling of material (pottery, slags etc.) to specify the dating of these constructions. Fieldwalking surveys were conducted both within the presumed fortified areas and, where accessible, in their immediate surroundings in order to identify associated settlement activities, displaced artefact scatters and terrain relics related to fortified occupation. Survey extent varied according to terrain accessibility, vegetation cover, land ownership and current land use, but generally included the fortified core and adjacent areas within a radius of approximately 50–200 m.

Field observations and site characteristics were systematically recorded using a standardized field documentation form developed within the project. The recording protocol included the classification of site type (castle, FMH, motte, etc.), topographic position, relationship to settlement structure, preservation state of architectural and fortification features, terrain morphology, visible masonry remains, earthworks, ditches, platforms and associated archaeological material. Surface artefacts were collected selectively or systematically depending on visibility conditions and recorded using GNSS.

Fieldwalking survey formed an important component of the non-destructive archaeological approach applied in this project. The methodology combined systematic topographic observation with surface artefact survey and documentation of visible terrain features associated with fortified sites. The applied recording strategy was inspired by established approaches in archaeological survey, landscape archaeology, non-invasive archaeological prospection and castle studies (e.g., Banning 2002; Mattingly 2000; Doneus et al. 2008; Schütz 2011, 2014; Drnovský 2022). The standardized recording protocol was designed to ensure methodological consistency and comparability across the investigated localities.

2.9 | Archaeology

Archaeological evidence ('Archaeology') was compiled from a combination of recent fieldwork and legacy data. In many cases, this evidence derives from older rescue investigations due to housing development (at locality 23—Dubicko, for example), available as unpublished excavation reports, or thanks to project-related research (i.e., at locality 100—Úsov). Defensive architecture was frequently encountered in those cases. Further information was acquired from historical building surveys and archival find records held by regional museums and heritage institutions (all excavation reports and historical building surveys relevant to our research are listed and cited in Supporting Information S2—column T). These legacy datasets were critically reassessed within the framework of the present project, with particular attention paid to stratigraphic integrity, dating reliability and the relevance of recorded features to fortified noble residences. The Archaeological Map of the Czech Republic (AMCR) and the State Archaeological List (SAL) were also consulted during the verification and localisation of selected sites (Archaeological Map of the Czech Republic 2026; State Archaeological List 2026). However, these databases largely compile information derived from previously published literature and archival records and do not systematically revise or critically reassess the interpretation, chronology or localisation of individual FMHs. These tasks constituted one of the objectives of the present research.

2.10 | Geophysical Survey

Non-destructive geophysical field measurements ('Geophysics') took place in those cases when the location of the FMH was unclear and when topography and plant cover made the geophysical survey possible. Electric resistivity tomography (ERT) and conductivity meter dipole (CMD; gfinstruments 2025a) measurements were selected for geophysical survey. Out of the two, CMD is less frequented, though it has been introduced relatively early in archaeological research (Tite and Mullins 1970; Kvamme 2003; Ernenwein 2018). Its advantage compared with, e.g., ground penetrating radar (GPR) or ERT lies in quick survey and usability in difficult terrain. In particular, the implementation of GPR survey would be problematic on steep slopes or deeply tilled fields, such as those encountered at the sites of Brodek u Prostějova and Čechy pod Kosířem (see below).

A rectangular area was selected in which parallel lines, spaced at 1 m, were measured in continuous mode. A pre-defined distance is walked in this case while the signal is continuously being acquired and evenly interpolated as measured points along the profile. Data collection time was set to 0.1–0.2 s. The depth range was set to High—this gives more reliable results than the Low mode and enables the interpolation of data at the depths of 0.5, 1 and 1.8 m (gfinstruments 2025a). Initial efforts with up to 50 m long lines have shown poor sensitivity upon interpolation so that the maximum length of each area (i.e., the walked distance) was devised to not overstep 25 m. The acquired data were processed in Surfer 12.0 software (Golden Software, United States).

ERT has been used to detect subsurface archaeological features, including roads, fortifications and other types of masonry in urban and suburban archaeological sites (Tsokas et al. 2011; Saey et al. 2012; Moník et al. 2018; Salvatore et al. 2019; Rusolillo et al. 2024, among others), as well as above-ground anomalies, for example in stone architecture (De Donno et al. 2017). Though cumbersome and expensive (Ranieri et al. 2016), ERT is reliable and, when using close spacing of electrodes, more sensitive than other geophysical methods used in archaeology. ERT was used in those cases where CMD measurements were promising, showing anomalies indicative of subsurface constructions. In that case, the ARES system (gfinstruments 2025b) was used, with electrode spacing at 0.5 m, Schlumberger distribution of electrodes, and processed in RES2DINV and RES3DINV software (Geotomo Instruments, Malaysia). Topography was measured with a levelling instrument and telescopic rod when the elevation was counted from the nearest elevation point (ČÚZK 2025).

3 | Results

3.1 | Historical Research and HM

When studying historical sources, archaeological, architectural and historical surveys, it turned out that of the 123 FMHs/castles originally planned to be investigated, only 79 were confirmed as undisputedly from the Middle Ages while 44 were discarded. The main reason for this reduction is that the nobiliary particle itself, which a noble person used to describe his/her domicile (like Jiří of Kunštát and Bouzov), does not necessarily mean that the person owned a fortified residence in a given location. Our historical research suggests that some of these noblemen inhabited mainly a residence building within a courtyard (*curia*), which was an object with mainly economic focus and without large fortification, typical for medieval castles and FMHs. Previous literature usually tried to connect nobiliary particles mentioned in the Middle Ages with later objects located in the same places; however, our broad-scoped research confirmed that many of these FMHs or chateaux were either built much later during the 16th century or that we lack clear historical or archaeological evidence for their medieval origin and the context of these locations and their owners does not support it. Figure 1 and Supporting Information S2 synthesise the evidence and research coverage for the set of 79 sites currently included in the working database. Figure 1 also comprises the 44 sites (black dots) eventually excluded from our dataset. Historical research was conducted for all confirmed entries/FMHs (79/79; 100%), forming the baseline for subsequent assessment and field targeting.

Evaluation of HM resulted in 31 positive cases (39.2%; Figure 2), where cartographic evidence of the 18th/19th centuries indicated remains plausibly attributable to the pre-AD 1500 horizon, and 48 negative cases (60.8%), where either no relevant remains were recorded or mapped features were judged to be post-medieval or absent.

3.2 | Remote Sensing

Shaded relief visualisations derived from ALS-based DTMs proved particularly valuable in cases where FMHs were not

included in the 18th–19th century military mappings (16 locations in all; Figure 3) or were difficult to access using geophysical survey methods. In total, 42 positive outcomes (53.8% of those where RS was used) were produced by RS—in those cases, LiDAR visualisations made terrain relics of medieval fortifications clearly visible. Thirty-six outcomes were negative (46.2% of those where RS was used). Overall, RS provided the highest rate of positive identification among the desk-based and non-invasive screening approaches, particularly where subtle earthworks or structural traces remained detectable despite later landscape transformation.

3.3 | Geophysics

Geophysical survey was applied only selectively within the study. In the current dataset, five sites yielded positive geophysical results, while five produced negative outcomes. Geophysical methods were employed primarily as targeted verification tools rather than as a broad screening approach. Where applied, the geophysical data contributed to a more precise spatial delineation of the presumed extent of subsurface masonry and to an assessment of the likelihood of preserved structural remains prior to any invasive intervention. Among the five sites with positive results (localities 89—Stražisko, 98—Unčovice, 23—Dubicko, 5—Bouzov, and 67—Brodek u Prostějova), two cases are discussed in greater detail (one as Supporting Information S3), representing one confirmed FMH and one probable castle identified in place of a previously assumed FMH. In addition, one site with negative geophysical results (Locality 10—Čechy pod Kosířem; Supporting Information S4) is presented, as the survey may nevertheless have indirectly indicated the location of a local FMH.

3.4 | Brodek u Prostějova (Locality 67)

The so called ‘tvrz nad Brodkem’ (‘FMH above Brodek’) is mentioned in historical sources from 1492 (Olomouc Land Tables XIV) at Brodek u Prostějova (Prostějov district), although some sort of a noble residence is here expected at least since 1439, when a local nobleman issued a charter ‘in Brodek’. Older literature usually located this FMH to a present-day yard called *Bažantnice* (pheasant farm), more specifically to a farm that currently stands there (Musil 2002); however, there is no archaeological evidence that would support this localisation. Another possibly medieval construction, whose position was indicated to us by crop marks (Figure 4) observable in aerial photography from 2004 to 2007 (available at mapy.cz 2025), probably stood some 350 m to the SE. The CMD measurement from September of 2025 has covered an area of 52×49 m (0.25 ha), measured as two areas, 25×52 and 24×52 m in size, for reasons of better sensitivity (see Methods). Linear anomalies of lower conductivity (> 15 mS/m) than the surrounding sediment were identified (Figure 4), which ran in accordance with the crop marks. These are likely a defensive stone wall and four rectangular stone buildings that composed the medieval complex. The NW defensive wall is not visible in either aerial photography or CMD plot and may have been destroyed by land tillage. Another small rectangular feature was observed in the southern part of the walled area. In the CMD-plot, it looks like a thickening of the

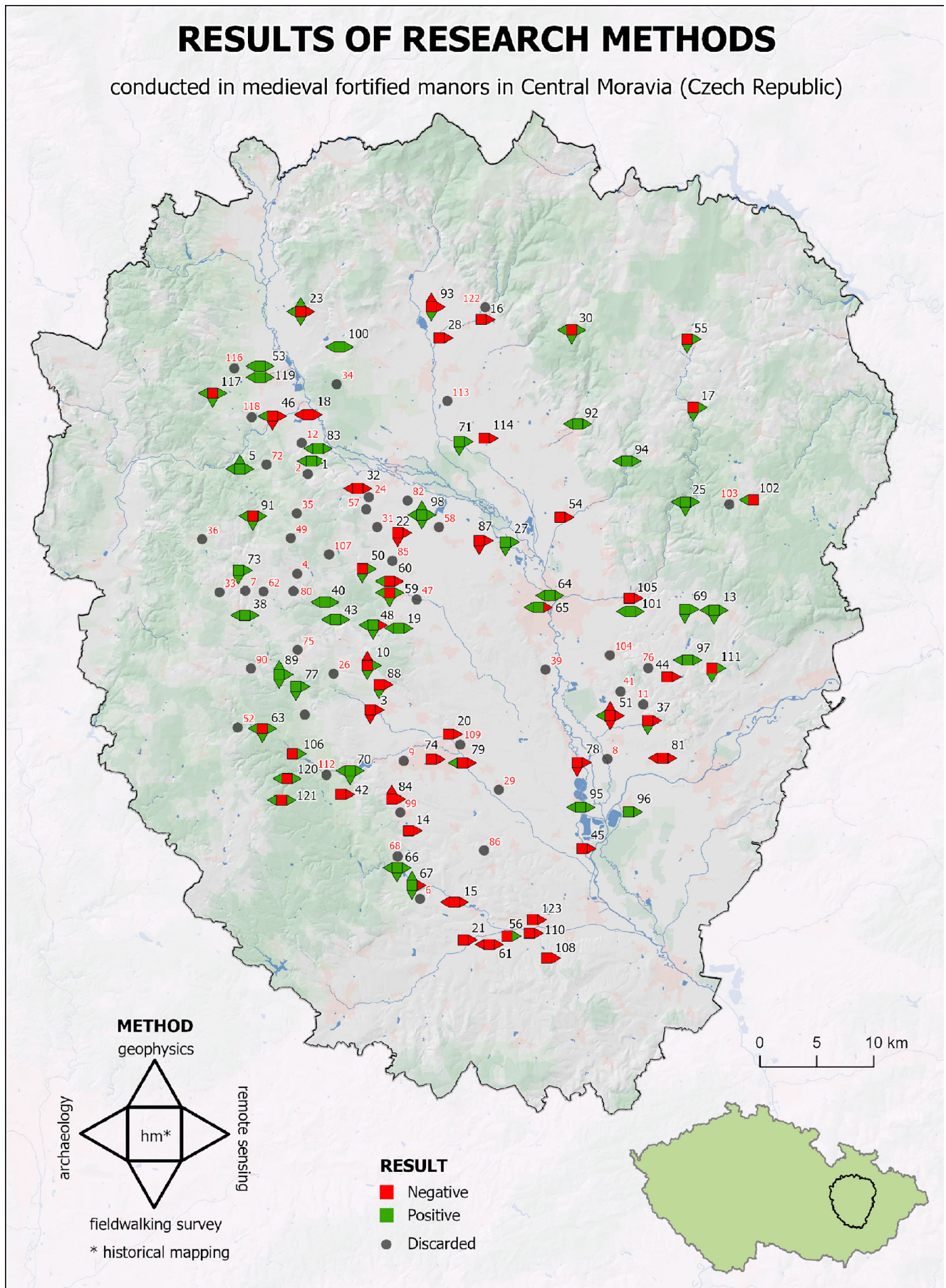


FIGURE 1 | Legend on next page.

FIGURE 1 | FMHs in Central Moravia, its position in the Czech Republic, and the results of different research methods. Black dots mark the 44 cases when presumed FMHs were excluded from the dataset for not being fortified or being of later than medieval age.

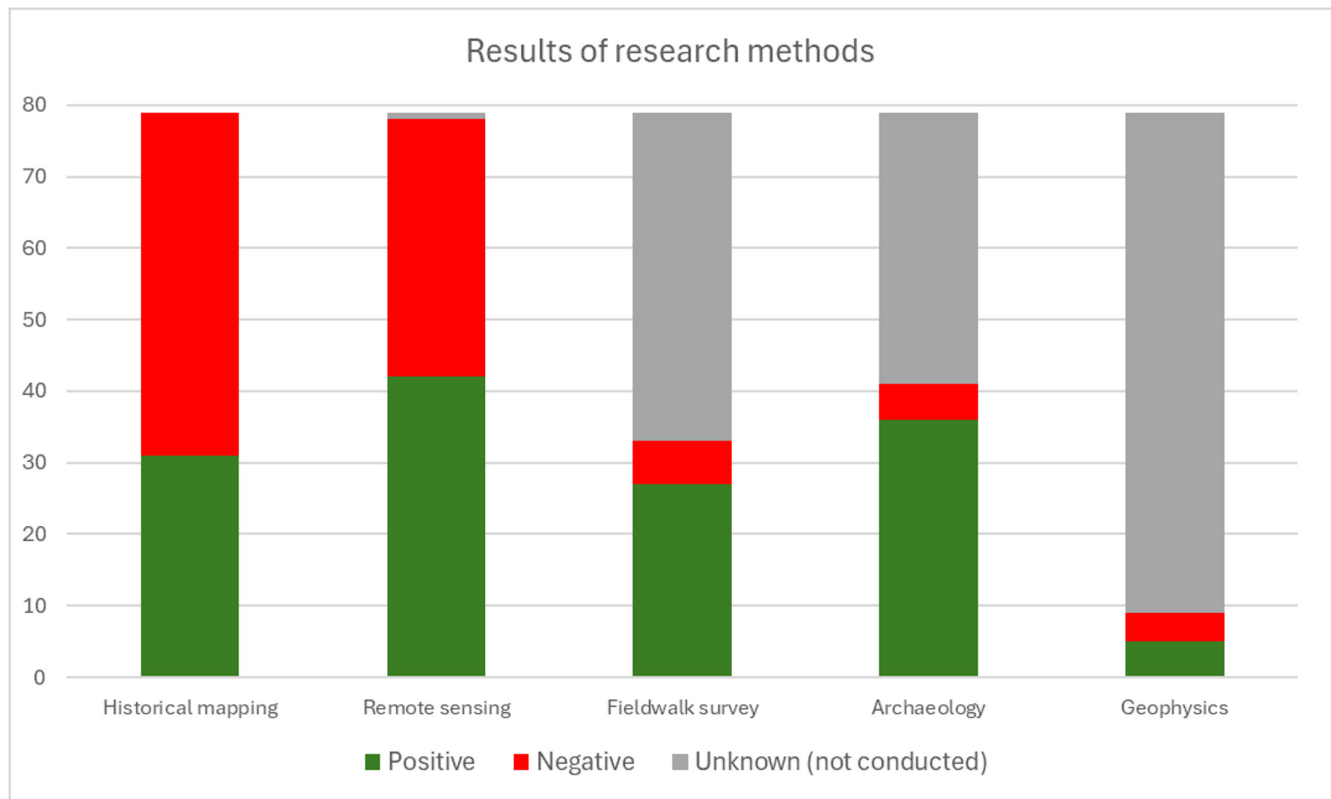


FIGURE 2 | Rate of success of the different methods used to identify FMHs in Central Moravia. Historical research was used as a background, establishing the 79 total FMHs to be verified by further methods. Successful identification/verification is marked as ‘positive’ in the graph, including its percentage out of the ‘performed’ cases.

defensive wall and may represent the original stone gate or a similar entrance in the area.

3.5 | Čechy pod Kosířem (Locality 10)

A 14th century FMH is reported to have been situated in the chateau park in the town of Čechy pod Kosířem (Plaček 1996). It was speculated that it lay beneath an early Modern church, which purportedly lies beneath today’s outlook tower (Supporting Information S4). In this case, only some areas were accessible for geophysical measurement due to forest cover. CMD conductivity measurements were again conducted in rectangular squares 3×10 to 22×25 m in size, covering a total area of 0.32 ha. An old church road was identified in the western part of the prospected area, rising steeply towards the tower hill (old parishioners were complaining about that). The position of local FMH was thus estimated only indirectly—it probably lies beneath the outlook tower, if it was not destroyed during the construction of a later church. Another possibility is the existence of a fortified manor on the site of the present Classicist chateau (north of the area visualised in Supporting Information S4). Kašpárková (2010) identified masonry fragments incorporated into the chateau. During the reconstruction

of the chateau, a remnant of a wooden beam was discovered, embedded within a wall constructed of roughly dressed stone bonded with lime mortar. Dendrochronological analysis dated the timber to the years 1555–1556 (Vrána 2013). This would exclude its medieval age, though.

A rectangular building was also identified in the east of the prospected area (Supporting Information S4). This one is probably more recent and has to do with 18th-century construction of the chateau park by Johann Adam I. Andreas von Liechtenstein.

3.6 | Archaeological Research

Archaeological excavations were conducted in 41 cases, fieldwalking survey in 33 cases. Results from fieldwalking survey show that outcomes are available for a smaller subset of the dataset: 27 sites yielded positive evidence (34%), seven were negative (9%), while 45 remain ‘unknown’ (57%), reflecting either the absence of fieldwalking or inconclusive/undocumented outcomes in the current dataset. Evidence from archaeology (excavation and/or historical building survey) is comparatively uneven across the dataset: 36 sites were classified as positive (46%), six

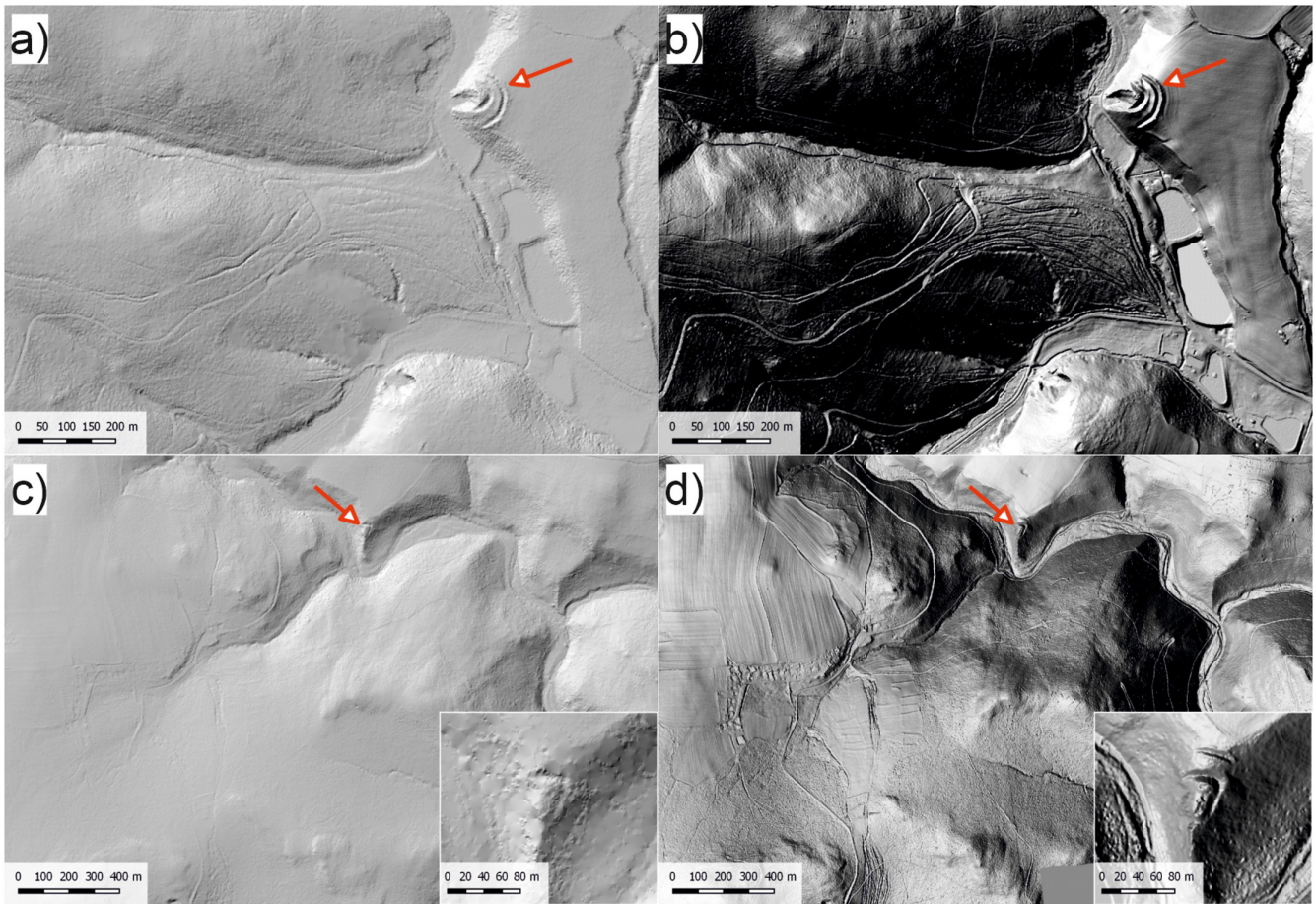


FIGURE 3 | Shaded relief visualisations derived from ALS-based digital terrain models with illumination azimuth set to 315°. Left: hillshades generated from the national DMR 5G dataset provided by the Czech Office for Surveying, Mapping and Cadastre (ČÚZK). Right: corresponding hillshade visualisations generated from newly acquired high-resolution ALS data processed for the purposes of historical landscape mapping. Examples include the FMH at Lišnice (a, b) and the Huzová Castle site (c, d). Both sites are known from historical sources but were not depicted in the 18th–19th century military mappings.

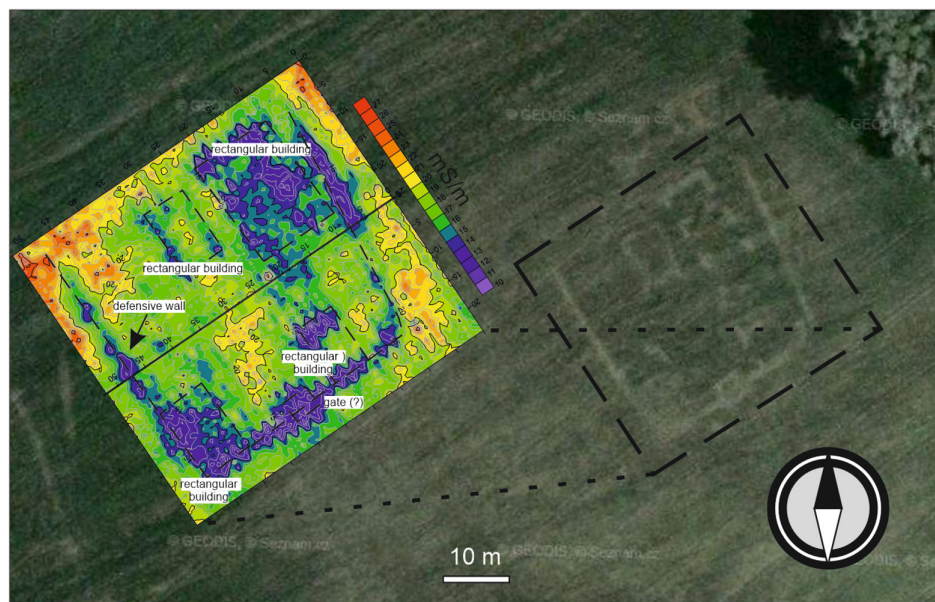


FIGURE 4 | CMD-Mini Explorer measurement in Brodek u Prostějova in orthophoto, interpolated at the depth of 1.8 m. The probable position of medieval masonry (of low conductivity, usually blue in CMD-interpolation) is marked by black dashed line. Note that crop-marks were key in the selection of the area to be measured with geophysics.

as negative (8%) and 37 as unknown (47%). Where available, archaeological data most often served to corroborate the medieval attribution and/or refine site interpretation (e.g., distinguishing between small, fortified residences and other forms of noble or ecclesiastical architecture).

An illustrative example of the contribution and limitations of archaeological evidence is provided by the castle of Špraněk (Locality 91). The site is known primarily from written sources and from pronounced terrain features, while standing architecture is preserved only fragmentarily. Archaeological evidence derives almost exclusively from legacy data and surface investigations, including older undocumented test pits and more recent fieldwalking surveys. These investigations yielded small assemblages of medieval material culture, dominated by ceramic fragments datable to the late 13th and 14th centuries, as well as dispersed building debris and lime mortar (Figure 5a,b; Hlubek et al. 2026).

Although archaeological research did not allow for the reconstruction of the ground plan or the precise architectural form of the castle, it independently confirmed the medieval origin of the site and corroborated its interpretation as a stone-built fortified residence. At the same time, the Špraněk case illustrates the limits of non-invasive and minimally invasive archaeology

at heavily eroded sites, where surface assemblages primarily serve a confirmatory rather than reconstructive role. In the framework of the present study, archaeology thus functioned as a key verification tool complementing historical research and remote sensing, rather than as a primary means of spatial identification.

A contrasting example of the archaeological contribution is provided by the fortified manor at Dubicko (Locality 23; Papajík et al. *in press*), where archaeological excavation played a decisive role in spatial identification. While historical sources and earlier literature associated the presumed manor with the area of the parish church and cemetery, rescue excavations conducted between 2021 and 2023 revealed that the fortified site was in fact located approximately 200 m east of the church, on a prominent ridge locally known as Na tvrzi ('At the fort') (Figure 5c).

The excavation documented a substantial curvilinear ditch enclosing the summit of the ridge, accompanied by occupation features and a rich assemblage of medieval material culture, including ceramics datable from the late 13th to the 14th centuries, metal artefacts (notably arrowheads) and building debris. The spatial configuration and archaeological evidence suggest a motte-type fortified residence, originally established in the

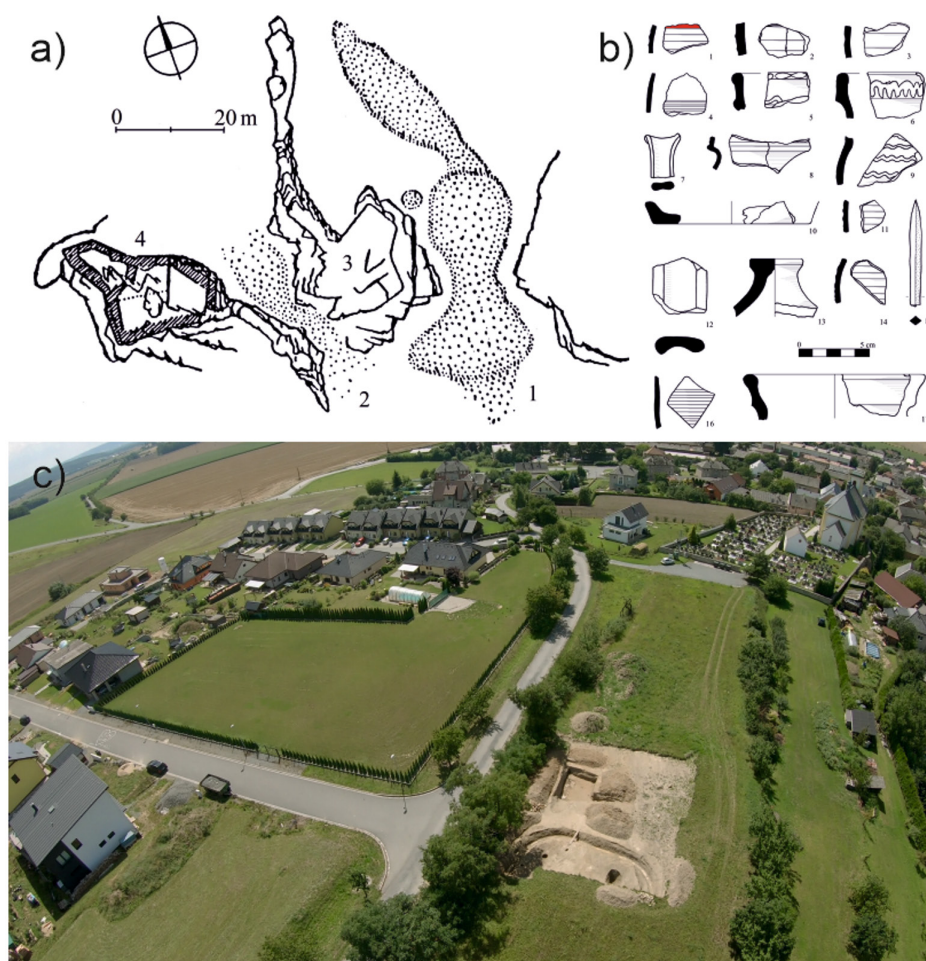


FIGURE 5 | Remnants of a small castle Špraněk (a) was identified, and associated material culture (b) acquired through archaeological research. Rounded fortification at Dubicko was identified only through archaeological excavation (c)—bottom of the image, as previous historical references located the site farther downslope, in the area of the present-day cemetery; (c)—top.

second half of the 13th century and abandoned by the late 14th or early 15th century.

In this case, archaeology did not merely corroborate a historically known site but fundamentally corrected its presumed location and character. The Dubicko example thus illustrates the critical role of targeted excavation in resolving ambiguities inherent in desk-based approaches and demonstrates how archaeological evidence can decisively refine the interpretation of medieval fortified manors within the combined methodological framework applied in this study.

4 | Discussion

Application of an integrated methodological approach to the identification of FMHs in Central Moravia (Czech Republic) demonstrated that of the 123 sites initially assumed to represent fortified manors, only 79 could be confirmed as constructions originating before AD 1500. One of the principal reasons for this discrepancy is that the presence of a nobiliary particle in personal names in historical sources does not necessarily imply the existence of a fortified manor at the individual's place of residence.

A comparison of the applied methods reveals marked differences in their effectiveness when verifying the locations of FMHs. In terms of absolute numbers, remote sensing proved to be the most effective method for verifying the locations of fortified manors mentioned in historical sources, confirming 42 sites. This was followed by archaeological research (36 sites, including historical building survey), analysis of historical maps (31), fieldwalking survey (27) and geophysical survey (5). When evaluated in relative terms, archaeological investigation and fieldwalking survey achieved the highest success rates (both exceeding 80%; Figure 2), followed by geophysics (55.6%), remote sensing (54%) and HM (39%). These differences largely reflect methodological biases in application: archaeological research was most frequently undertaken at sites where structural remains were still visible on the surface, whereas remote sensing and geophysical survey were often applied to locations lacking discernible terrain features and therefore yielded lower success rates. The use of the relatively underutilised CMD in archaeo-geophysics was validated by the successful identification of several fortified manors; however, when employing continuous measurement modes in comparable research, relatively small survey areas ($\leq 25 \times 25$ m) are recommended. A limitation analogous to that affecting remote sensing and geophysical survey also applies to historical cartographic sources, as many FMHs had already been destroyed, overbuilt or obscured by sedimentation by the eighteenth and nineteenth centuries (cf. Schütz 2014).

Particularly significant are the 12 cases in which previously undocumented FMHs were identified during the course of this project (Supporting Information S2). Of these, three sites were located with high spatial precision (Brodek u Prostějova (locality 67), [Figure 4], Lysov (locality 50) and Luděšov (locality 48)), while a further nine were identified with approximate location accuracy (location precision categories 1 and 3 in Supporting Information S2). The remaining confirmed sites correspond to

FMHs already known from earlier research, published literature or other forms of prior identification.

The collected data indicate a markedly uneven spatial distribution of FMHs in Central Moravia. Notably, the area surrounding the regional centre of Olomouc, where two castles were located, forms a zone with a diameter of approximately 20 km in which no FMHs are attested (Figure 1). This pattern reflects the sphere of influence of the royal city of Olomouc and alternatively the margrave, within which the establishment of competing fortified residences was restricted by a privilege issued by king John of Luxembourg in 1331 (Chlumecky and Chytil 1854), even resulting in a deliberate (or at least attempted) destruction of some rival castles and FMHs slightly outside the observed perimeter by burghers of Olomouc during the hussite wars in the 15th century (Plaček 2001). Comparable, though smaller, exclusion zones are observable around the principal seats of influential noble families, such as the castles of Šternberk (locality 92) and Plumlov (locality 70).

FMHs were therefore predominantly situated outside the spheres of influence of major royal cities and powerful landowners, and preferentially on agriculturally productive soils. This spatial pattern accounts for the higher density of FMHs in the eastern and southern parts of the study area, whereas the northern and western regions, characterised by more rugged terrain and lower agricultural potential, exhibit significantly fewer examples. The numerical predominance of FMHs over castles further reflects the representational and defensive needs of the lower nobility, for whom the construction of large, fully developed castles was financially prohibitive. Following AD 1500, the consolidation of estates through acquisitions by wealthy noble families played a major role in the decline and disappearance of many medieval FMHs, while other objects (mainly castles like Šternberk, Bouzov or Plumlov) were in later centuries rebuilt or integrated into chateaus to accommodate changing needs of their inhabitants. Regarding unlocalized FMHs (mainly categories 4 and 5 in the Location Precision column in Supporting Information S2), we are unfortunately unable to determine the exact reasons for their disappearance, assuming in many cases their abandonment rather than forced destruction.

Owing to the complexity of this issue, we decided not to incorporate a detailed analysis of territorial holdings and their owners into the present study. Instead, these data will be included in a specialised database (see the following paragraph). Changes in selected regional holdings of major noble lineages, such as the House of Šternberk and the House of Kravaře, during the 14th and 15th centuries will be presented in a dedicated map illustrating the extent of these estates, their territorial development and their associated hinterlands.

The combination of methods applied in this project proved effective and can be recommended for future studies focused on immovable anthropogenic monuments. Only 24 fortified manors were not corroborated by methods other than historical research, whereas the remaining 55 sites were confirmed by at least one independent line of evidence. To ensure public accessibility, detailed research of all localities is currently ongoing, and its results will be presented through a dedicated web portal incorporating a GIS-based interactive thematic map

and a database with advanced search, selection and filtering functionalities. The results concerning the effectiveness of the applied methods are already publicly accessible (<https://mujdummujhrad.upol.cz/verification/>). Once completed, the platform will provide heritage authorities, conservation professionals and archaeologists responsible for safeguarding national cultural heritage with an effective tool for risk assessment and management relating to medieval fortified manors. Furthermore, these sites may serve as drivers of regional tourism, representing both an economic opportunity and a potential risk to their preservation.

5 | Conclusions

A complementary set of methods drawn from historical research (written sources and historical maps), socio-historical disciplines (archaeology) and the natural sciences (remote sensing, geoinformatics and geophysics) was successfully applied to identify the locations of 79 FMHs in Central Moravia (Czech Republic). The resulting map and database are of particular significance at a micro-historical scale, while also allowing comparison with analogous research initiatives across Central Europe. Moreover, the multimodal methodological framework is transferable to other regions and to immovable anthropogenic structures, including fortifications, regardless of their chronological context.

In addition to the indispensable heuristic analysis of historical sources, remote sensing and fieldwalking survey proved to be the most effective non-destructive methods for identifying FMHs, whereas the analysis of historical maps yielded more limited results than anticipated. Archaeological investigation, although frequently destructive, was proportionally the most successful method overall, confirming 88% of the examined sites. Geophysical survey was applicable but comparatively less effective than most other methods, likely due to the limited preservation and spatial precision of information relating to High Medieval FMHs.

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Data Availability Statement

The data that support the findings of this study are openly available in Mendeley Data at <https://data.mendeley.com/drafts/cv26bj872v>, reference number 10.17632/cv26bj872v.1.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** Supporting Information. **Data S2:** Supporting Information. **Data S3:** Supporting Information. **Data S4:** Supporting Information.