Article

Understanding the Basis of Schmitt’s Map of South Germany: Georeferencing the Sketches of Staržinsky and Sarret (Late 1790’s)

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Abstract: Schmitt’s map was one of the outstanding survey products of the late 18th century, produced through Habsburg military mapping in the shadow of the Napoleonic Wars in the area of today’s southern Germany and some neighboring regions. The main geodetic basis for the map work was the series of surveys in Germany conducted by C.-F. Cassini de Thury in the 1760s. However, this was only a horizontal control for part of Schmitt’s map. The Cassini survey chains were linked in the 1790s by a complementary survey in the northern part of the map work: the Staržinsky-Sarret survey, which is the subject of this study. The authors have searched through the archive summary drafts of this survey. The georeferencing of the photographed sketches in the Cassini projection was feasible with surprisingly low error. By using the global SRTM elevation database, it was possible to identify the points/summits of the Staržinsky-Sarret survey between which visibility is possible. Thus, despite the fact that only one of the seven map sketches examined explicitly presents a triangulation structure, we present a possible triangulation pattern that could have been used to provide geodetic control in the northern part of the Schmitt map. The authors consider this survey as the basis for the assumption that georeferencing the Schmitt map in its own projection is possible in this area with relatively small residual errors.

Keywords: Staržinsky-Sarret survey; Schmitt’s map; 18th century; georeferenced; historical cartography

1. Introduction

The world’s first large-scale map showing a territory in many sections but with a uniform geodetic basis and projection methodology was the Cassini map of the Kingdom of France (Carte de la France), produced in the mid-eighteenth century [1]. This technology quickly spread in Europe. By the end of the century, maps using similar technology had been produced in the Low Countries [2], Denmark [3] and Norway [4]. In the central part of Europe, in the territory under Habsburg rule, French technology was also used to produce the First Military Survey map [5,6]. Cassini’s method was also used in Germany, where Cesar-François Cassini de Thury (Cassini III) triangulated along the Danube carrying out geodetic measurements between Brest and Vienna [7,8]. The Kurbayerische Akademie der Wissenschaften also started a country survey along this work, but for financial reasons it had to be canceled. In the end, only two copper engraved maps of Bavaria were produced, both by St. Michel, one of Cassini’s collaborators [9]. The product was Schmitt’s map [5,6], covering the southern part of Germany with the Austrian provinces of Tyrol and Vorarlberg, with some adjacent areas in France, Switzerland and Liechtenstein (Figure 1).
The literature has long been divided on whether maps of this period have a geodetic basis. For some map works, the triangulation base is documented and proven, and the base coordinates are available in some systems, so that these maps can be georeferenced in their own system. In other cases, such archival documents are not yet available and the geodetic basis is disputed [11]. For example, in the case of the Habsburg First Military Survey, the direct predecessor of Schmitt’s map, the geodetic basis is assumed to be related to the contemporary arc measurements, which explains why large-scale mapping work generally shows uniform accuracy. The residual errors in this case are caused by errors in detail measurements based on bench and graphic triangulation, which are made when aiming at relatively distant base points [12].

However, as the authors of this paper have shown in a recent paper, the Schmitt map has only a partial geodetic basis. Jean-François Cassini de Thury carried out several documented surveys in the 1760s, which were later used for the Schmitt map and are now available to anyone on Google Books. Based on this and other local surveys, a revised initial sketch was drawn when the map was produced. On this sketch, the future sectional layout of the Schmitt map, the Cassini baselines and other easily identifiable landmarks were marked. The sketch also shows the Paris starting point coordinate system used for the Cassini basepoints, in contemporary French ‘toise’ units. The mapmakers used these as a basis for producing the sections via manuscript copying of previously produced maps. Actual field surveys were possible only where no previous cartographic information was available, due to the limited time available [10].

The northern part of the Schmitt map, however, had no such points with coordinates in the Paris system. The island-like local Cassini systems here—one in the Würzburg and

Figure 1. Coverage of the Schmitt’s map of South Germany (from [10]). Green and purple lines indicate the triangulations of Cassini (1760s). The Danube and Rhine chains are connected to the French network and thus to Paris at Strasbourg. The two northern (Würzburg, Bayreuth) and one small southern (Salzburg) purple networks are not connected to the abovementioned chains. Vienna War Archives, signature of Schmitt’s Map: B IV a 72-1.
Coburg area and one further east around Bayreuth—were not connected to the main chains, so only the angles observed at the points are available, not the coordinates (Figure 1).

The authors have found a series of field sketches in the Military Archives of the Staatsarchiv in Vienna (Vienna Military Archives), showing the position of the field points from the end of Cassini’s Rhine survey chain near Frankfurt am Main, through the local Cassini networks mentioned above, to Ingolstadt and Regensburg on the Danube, i.e., the Strasbourg–Vienna chain. The authors could not find a list of coordinates for these documents. Of the seven sketches, only the western sketch, showing the Eifel mountain range, contains an explicit reference to a triangulation network [13].

Timár and Kiss [10] have previously shown that the Cassini projection is a good mathematical model as a projection of Schmitt’s map. They compared the accuracy distribution of the Schmitt map with the location of the Cassini triangulation chains and found that the horizontal errors along the chains are significantly smaller. However, the error was also found to be lower in the northern part of the map, where Cassini did not perform chains but isolated local surveys. According to the literature [10,13], additional surveys were made here in the 1790s. The present work focuses mainly on this survey and shows the following:

- the found archival records of these surveys;
- the attempts to georeference these map sketches in the previously assumed Cassini projection [14].

Georeferencing in this projection can support further the authors’ hypothesis that the Cassini coordinate system can be well applied as a first step if georeferencing Schmitt’s map. The map can be georeferenced in this projection using a linear or Helmert transformation with a similar accuracy as using a quadratic transformation in other projections.

2. Data and Methodology: Study of the Schmitt’s Map
2.1. The International Origin of the Map

The Napoleonic Wars gave a major impetus to the territorial expansion of cartography; one result of this period is Schmitt’s map, commissioned by the Austrian military command, showing the southern part of present-day Germany and the Austrian province of Salzburg at the turn of the eighteenth and nineteenth centuries. The title of the map should, of course, be interpreted in the context of the geopolitical conditions of the past, not of today. The area covered by Schmitt’s map, refers to the southwestern part of the declining German–Roman Empire, the so-called ‘Old Empire’, at the end of the eighteenth century.

The First Military Survey of the Habsburg Empire was officially completed in 1787 [5,6]. The wars against France had not ended by then but were shifted to Southwestern Germany in 1790. Since Prussia was in alliance with Austria, the Austrian cartographers continued their work in this area, as a sort of continuation of the First Military Survey, producing further series of maps for this area. From 1792 onwards, these maps were island surveys of Württemberg as well as Baden, the bordering Palatinate and Hesse–Nassau. These four regions were combined in 1797 and then embedded in the single map work under study in this article [15]. The German principalities would not have been able to create such a unified map work on their own [16]. This was possible thanks to the excellent cooperation between foreign military cartographers and the Bavarian authorities [17,18].

2.2. Timing of the Survey Work

The survey of the area covered by Schmitt’s map and the production of the map were completed in just twenty months during 1797–1798. Thus, the speed of the survey took precedence over accuracy. This rapid progress can be explained by several factors. One reason is certainly that the First Military Survey was carried out by highly experienced surveyors and officers, mainly Austrian. Moreover, researchers of Schmitt’s map even assume that Schmitt’s map was based on the instructions of this earlier survey in the Habsburg-Hungarian monarchy. On the other hand, the short time needed to produce the map can also be explained by the fact that older surveys were linked together and
presumably information from Riedl’s earlier Road Atlas of the Kingdom of Bavaria was also taken [18].

The preliminary mapping and the Schmitt’s survey can be divided spatially and temporally as follows:

- 1793–1794: Rhineland from Basel to Mainz, Luxembourg and the right bank of the Moselle River;
- 1795–1796: Rhineland from Mannheim to Kaub (Caub), and to Trier and Heidelberg;
- 1796: River Lahn from the demarcation line (Giessen), Upper and Lower Bavaria, Upper Palatinate (Altbayern) and parts of the Salzburg region [19,20].

Until 1796, incomplete surveys were carried out. In April 1797, during the siege of Kehl, Archduke Charles commissioned Quartermaster General (Generalquartiermeister) Schmitt to connect and to join the island-like territories and to carry out additional re-surveys. He put him in charge of the entire survey of Southwestern Germany, while Adrian von Riedl was assigned to map the area of Salzburg, as well as Lower and Upper Bavaria.

The annexation of the Rhineland took only six months. After the peace treaty of Campo Formio, peace prevailed for a year and a half, but the Austrians could no longer enter the territories west of the Rhine. In this period of peace after the peace treaty of 17 October 1797, the parts of the Salzburg region, Upper Bavaria, Lower Bavaria, Upper Palatinate, Franconia, Württemberg and Baden and Hesse–Nassau were surveyed without external threat.

The survey and mapping scale chosen was half the military scale, 1:57,600, which corresponds to half of the scale used in the Josephinian Land Survey (Josephinische Landesaufnahme), 1:28,800. The exception is the survey of the Lahn River, which was measured at a scale of 1:28,000 [18].

2.3. The Further Fate of the Map

The map project was classified top secret. The original plan was to continue mapping and to incorporate the map work into the First Military Survey. This idea was finally put to an end by an Electoral Decree of 1800, which declared the surveys worthless and stopped them [20]. Still, a few years later, a more accurate survey and mapping of the area was indeed produced, the Carte de la Bavière [18]. However, the developments in military-political relations no longer made the map necessary. Thus, the map sections were transferred to the Vienna Military Archives, where they have been kept ever since.

2.4. The Importance of the Map for Different Disciplines

For landscape research, Schmitt’s map is a special source material, since the short survey period makes the mapping a virtual snapshot of the natural and cultural landscape in the pre-industrial period.

The map is particularly interesting because it identifies the former moors, which is very important information considering the fact that 95% of the moors in Germany have been drained. It is a proven fact that wetlands and moors are the most efficient CO\textsubscript{2} reservoirs, and their restoration and re-nourishment is therefore important for environmental protection. The map helps to identify areas that were once covered by wetland moors.

According to the literature, the cartographic significance of Schmitt’s map lies in the fact that it is the last purely graphical map, thus marking a caesura in the history of military cartography in Central Europe [18]. The authors dispute this, trying to prove that the cartographic work was preceded by trigonometric surveying. Regardless of this challenge, this map remains a significant cartographic work, as in a very short time a huge area has been surveyed and mapped with surprisingly good accuracy.

2.5. Geodetic Basis and Survey Method, According to the Literature

Paldus mentioned in 1919 that the map work was based on the graphic triangulation of Lieutenant Colonel (later Major-General) Karl Staržinsky von Bittkau (1752–1816) [21] and Captain Sarret (biographic data unknown) [6]. However, the most thorough researcher
of the map, Stigloher, found no trace of this survey material in the Vienna Military Archives. At the same time, Stigloher found a draft of the ‘Overview-scelett for the large map taken by the general staff’ (Scelett zur Übersicht der großen durch den Generalstab aufgenommenen Karte) in the Schmitt’s map material in the Vienna Military Archives. On this draft, the following note can be found: ‘the Paris meridian and its perpendicular (perpendiculaire), rotated 5° (alt degrees) east of the reference frame’. However, there is also a pencil comment on the page: ‘useless’. The authors found, in the same archive, a sketch showing the coordinate system of the Paris starting point and the rotation, as mentioned in the Introduction—there is a slight possibility that it was another part of this document (Figure 2). Ultimately, Stigloher concludes that the triangulation material is either lost or not produced, and that the survey had no geodetic basis. Most experts accepted this view [18].

Figure 2. Part of a sketch, found in the Military Archive of the Austrian State Archives (folder B IVa 72-1) by the authors [10], showing the sheet system of the Schmitt’s map with coordinate lines of the Paris-centered Cassini projection, in toïse units [22]. The coordinate system is rotated indeed by 5 degrees as it was given by Stigloher [18].

Similar to the method of the First Military Survey, the first-order and second-order triangulation points were recorded using Dumont’s Ordnance Survey table method of graphic triangulation [6]. No calculations were required for the survey. This means that, once the meridian lines had been determined in the field using sextants, the other points of the topographic survey were determined along these lines by pre-cutting on the plane table. In the case of graphic triangulation, unlike true triangulation, the continuous pre-cutting is effectively extrapolated from the small to the large. The errors occurring at the connection points were graphically distributed (cf. also the Supplementary Materials) [18].

The detail points were plotted ‘à la vue’ on a small scale table between the base points, measured via stepping, or riding, or just estimating. Schäfer [23], referring to Oehme [24], claims that new points were added based on already-known points, and that the use of points fixed earlier (in our context, geodetic frame grid points) can be assumed.
In quantifying the accuracy of a map work, the earlier literature distinguishes between absolute or external accuracy and relative or internal accuracy. The former describes the distortion of the degree grid. This type of accuracy can be compared to the error of georeferencing as a uniform data system. The relative error is the ratio of the field distances read from the map in some parts of the area to their actual distance values today [18].

According to Stigloher, the absolute error, compared to today’s Gauss-Krüger projection of topographic maps at a scale of 1:200,000, is a maximum of four kilometers; the average position error of the section corners is two and half kilometers and the angular errors in the degree grid are less than three degrees. The relative error averaged 7% over 163 distances, averaging fifteen kilometers over the whole map area, with lower values (around 6%) in Upper Franconia and around 10% in Danube Bavaria, rising to 13% around Rosenheim. In the same area and in the Alps, Finsterwalder notes an increase in the scale ratio of 5% [19]. Hagel, examining sections 61–62 (Tübingen area), also found relative errors in places larger than those mentioned above [25].

In a recent study by Timár and Kiss [10], it was found that the average position difference at 130 ground control points between their Cassini coordinates according to a simple Helmert-type georeference of the map mosaic (cf. also [26–28]) and their true terrain position is slightly above one kilometer, and at the extremes, it is almost five kilometers, which can be reduced to 200–500 m using NTv2 technology [29–31].

Timár and Kiss have already shown [10], based on archive sources, that the projection (coordinate system) of the Schmitt map is the Cassini projection with the Paris Observatory as the starting point. This projection is a functional relationship between spherical polar coordinates (latitude and longitude) and map plane coordinates, which can be derived from Cassini’s survey descriptions. It is known as the Soldner or Cassini-Soldner projection as a result of Johann Georg Soldner’s (1776–1833) generalization for the ellipsoidal formulae [14]. Of the axes passing through the starting point of the Cassini projection, the one pointing north is known in German as the ‘Meridian’ and in French as the ‘Méridien’, while the line perpendicular to it and extending from the starting point in a west–east direction but veering away from it towards the south is known in German as the ‘Perpendickel’ and in French as the ‘Perpendiculaire’. The use of these terms on any map or sketch map is a clear indication of the application of the Cassini projection (Figure 2). And in the sketch map mentioned in the introductory section, the coordinates of the Cassini projection are given precisely along these axes, as are the coordinates of the base points in the Cassini books [7,8].

Cassini did two coherent chains of surveys in Germany. The first is an extension of the Paris ‘Perpendiculaire’ to the city of Vienna. The second survey was carried out in Southwestern Germany; it covered the Rhineland, Württemberg, Hesse and nearby areas. Both are in the Cassini projection starting in Paris and were linked to the French ‘basic geodetic network’ at Strasbourg. Cassini also gives the points and values of the angles of three isolated triangulation networks: the Würzburg-Schweinfurt-Coburg-Bamberg region, the wider region of Bayreuth and the narrower region of Salzburg in Austria (Figure 1).

Timár and Kiss used the mosaic map compiled from the scanned sections [10] of the MAPIRE project [32] as a starting point. It is a very large image, 110,000 × 97,500 pixels, made by a simple image processing of the 197 sections scanned at 300 dpi resolution. The individual sections were not distorted during this process; only shifting and rotation were allowed. The authors searched for matching points (GCPs) on the image movies, with a uniform spatial distribution. For the Schmitt’s map, 130 points were used. These were used to georeference the map work in the relevant UTM zone by longitude (here, UTM zone 32) using quadratic transformation. The resulting ‘raw’ georeferenced dataset is further refined using a correction grid (a variant of NTv2) containing the residual errors of the 130 points mentioned above. The above procedure is performed using the Global Mapper software.
For the Schmitt’s map, the average accuracy after ‘raw’ georeferencing is around 2 km. By applying the correction grid and condensing the grid points, in principle, any accuracy can be achieved. With the 130 points for the georeferenced version of the Schmitt’s map available on the MAPIRE interface, the accuracy lies in the range of 600–1000 m [10].

To prove the correctness of the assumption, the image mosaic of sections used in the MAPIRE project was georeferenced to the Cassini projection with Paris origin, using a simple linear or Helmert transformation. As a result, the map sections in the above projection remain undistorted. The accuracy of the resulting dataset is comparable to that of the quadratic transformation into the UTM projection. This alone suggests that the Cassini projection with the Paris origin is a possible model for the coordinate system—and a much better model than the UTM projection, providing less accurate georeferencing.

3. Results: Survey Sketches of Lieutenant Colonel Staržinsky and Captain Sarret

Following Paldus [6], Stigloher mentions that Lieutenant Colonel Staržinsky and Captain Sarret made a survey, but he could not find it [18]. The authors found sketches of this survey in the Vienna War Archives (Figure 3 and Supplementary Materials). The seven survey sketches show a network of points from Frankfurt to Ingolstadt and Regensburg, thus effectively linking the two isolated Cassini networks around Würzburg–Coburg and Bayreuth to the northeast of the Rhine and Danube Cassini chains. The authors did not find any coordinate indexes for the Staržinsky-Sarret sketches, and although the sketches have interesting editing aids and additional information, their interpretation has not been deciphered. Given the fact that Staržinsky’s name appears in the list of officers on the Schmitt’s map as the Quartermaster General Staff (Generalquartiermeisterstab), and that the survey was carried out directly before Schmitt’s map, the authors assume that it was used to produce the latter map.

![Figure 3](image_url) The names of the surveyors, Captain Sarret and Lt. Colonel Staržinsky, in one of the sketches (Military Archive of Vienna, folder B IVa 72-2).

Unfortunately, the four Staržinsky-Sarret sketches in the archive could not be scanned, only photographed. Due to the geometric structure and distortion, this is a significant difference and should be taken into account for georeferencing.

4. Discussion 1: Georeferencing of the Survey Sketches of Staržinsky and Sarret

The maps themselves are orthogonal mappings, and the scanning does not change the internal geometric structure of the document; what is rectangular in the original document will be so in the scanned image, what is parallel will remain parallel. However, if one takes a photo of document, its sides will not be rectangular or parallel anymore. By taking a
photo, the structure of the internal geometry of the document will be changed; in other words, the image will be perspective-distorted (Figure 4).

![Orthogonal projection vs. Perspective projection](image)

**Figure 4.** Geometric difference between the orthogonal projection (scanner) and the perspective projection (camera) and the position of the mapped points on the image surface.

Simple georeferencing will not be applicable in this case, because the perspective distortion first has to be eliminated. Luckily, in the practice of surveying, there is a data capturing tool that uses photographic techniques, namely aerial photography. The authors have the technology to georeference aerial photographs, which includes orthorectification, and this is available in geographic information systems. The survey sketches found and photographed in the Vienna War Archives were georeferenced as if they were aerial photographs.

The original survey can be modeled best if the original projection used for the survey is given using georeferencing. As a novelty, the authors used the Cassini projection.

Several georeferencing/orthorectification software tools were tried. The most user-friendly was the Projective Mapping feature of the QGIS software’s Georeferencer module, adapted to photography with excellent results, with errors around 300 m [33].

In this way, the seven survey sketches could be fitted together. They show a network of points from Frankfurt am Main to Ingolstadt and Regensburg. This already suggests that the two isolated Cassini chains around Würzburg-Coburg and Bayreuth are connected to the Rhine and Danube Cassini chains, but this has not yet been proven.

5. Discussion 2: The Staržinsky-Sarret Survey as a Triangulation Chain?

Unfortunately, the triangulation network is only marked on the Staržinsky-Sarret survey in the area north-northwest of Frankfurt. In the other areas, no triangulation sketches have survived.

There are two types of references to triangulation in the Staržinsky-Sarret sketches. On the western sketch of Frankfurt-Eifel-Hessen area, and on its enlargement showing the vicinity of Giessen, the triangles and also the baseline are clearly marked. Also, there is a sketch, the most important part of which is shown in Figure 5, showing the area between Cassini’s two ‘island-like’ local networks. Here, in addition to the points belonging to the Cassini network, highlighted with a letter, a point is also highlighted with a letter that was not surveyed by Cassini but is part of the Staržinsky-Sarret survey. The usage of the same point in the surveys in the 1760s and 1790s is not surprising, since Cassini used mostly summits. An interesting question that cannot be answered from the available data is whether the angular values of Cassini’s island-like network were used by the authors of the Staržinsky-Sarret survey.
An interesting question that cannot be answered from the available data is whether the angular values of Cassini’s island-like network were used by the authors of the Staržinsky-Sarret survey.

Thus, it can only be assumed that the highest points were the triangulation fix points. However, how can they be found remains a question.

The mutual visibility can be checked easily on the field (Figures 6 and 7). However, the SRTM topography model was used to reconstruct the assumed first-order triangles. SRTM is an acronym for Shuttle Radar Topography Mission. It is a detailed elevation model produced by NASA in which, although it reflects elevation conditions in the year 2000 [34], it is assumed that no significant changes have occurred since the late eighteenth century in terms of the elevations relevant to the survey.

By fitting the georeferenced survey sketches to the SRTM, the highest elevations immediately stand out. The authors considered those points as priority points that overlapped with the highest altitude points of the SRTM elevation model and/or with Cassini’s isolated chains. These were virtually connected by triangles (Figure 8).

It is clear from the diagram that the Staržinsky-Sarret survey of the 1790s connects Cassini’s isolated northern sub-networks without coordinates, with the Danube and Rhine chains directly linked to Paris. Thus, it connects the northern end of the Rhine chain (Mannheim–Frankfurt) with the Ingolstadt and Regensburg branches of the Danube chain, and also links the two parts of the Danube branch (Figure 9).

However, even with all the considerations listed above here, we cannot prove that the whole length of the survey was developed as a triangulation chain. Survey triangles were only documented in the westernmost sketch. The other sketches, although they include the points of the two local networks apparently triangulated by Cassini, cannot be evidenced to include points defined by “first-order-like” triangulation; however, the georeferencing accuracy refers to this.
Figure 6. Part of a survey sketch, showing the terrain between the Hansgörgel (top) and Rauher Kulm (in the map: Culm; bottom right) summits.

Figure 7. From the Rauher Kulm, many of the points indicated in Figure 5 are visible. This is the view line to the Hansgörgel. Photo by G. Timár, with the skyline provided by the PeakFinder application.
By fitting the georeferenced survey sketches to the SRTM, the highest elevations implemented by "first-order-like" triangulation; however, the georeferencing accuracy refers to this.

Figure 8. The Staržinsky-Sarret survey chain (assumed partially to be triangulation), connecting the Cassini triangulation chains at the northern edge of Schmitt’s map along the Main River between the Danube and Rhine. Of the points provided, the triangulation points were assumed where the SRTM elevation model shows summits, which allows the visibility between them [13].

Figure 9. Mosaic of Staržinsky-Sarret survey sketches found and photographed in the Vienna Military Archives, then georeferenced via orthorectification. It can be seen that the Staržinsky-Sarret survey connects the island-like northern networks into the ‘green’ ones, thus connecting them to Paris in Cassini’s mapping system. Vienna War Archives, archive folder: B IV a 72-2 [13].

6. Conclusions

The original assumption that Schmitt’s map must have had a geodetic framework is supported by the following facts and conclusions:

A good mathematical model for the georeferencing of the Staržinsky-Sarret point network is the Cassini projection with the Paris origin. When applying the orthorectification, the average error of the horizontal control is 300 m, while at the extreme outliers it is slightly above half a kilometer. This further supports the hypothesis that the projection of the Schmitt map was the Cassini projection centered on Paris. However, this does not explain the auxiliary line system shown in the sections.

Before Schmitt’s map was constructed, the two isolated surveys of ‘Lower and Upper Franconia’, which were not originally connected to the Cassini Danube and Rhine chains
but were also surveyed by Cassini, were geodetically connected to the Paris-based network. This created the Schmitt’s map grid, which is now not only along the two major rivers, but is also in the north-northeast, which provided a solid geodetic basis for rapid mapping and map compilation works.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/geographies4030027/s1, The seven photos of Staržinsky-Sarret sketches of the Vienna Military Archive, folder B IVa 72-2. Figure S1: Region of Bamberg-Coburg-Nürnberg; Figure S2: Region of Ingolstadt-Kulm; Figure S3: Region of Kulm-Regensburg; Figure S4: Region of Würzburg-Bamberg-Coburg; Figure S5: Region of Forzheim-Coburg-Hansgörgel summit; Figure S6: Region of the Eifel and Frankfurt am Main; Figure S7: Region around Giessen. Note that these figures are pasted images and the orthorectification cannot be applied to them. Dataset D1: the Google Earth layer in KMZ format, showing the geo-referred Staržinsky-Sarret sketches.

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