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Carte Pisane and its coastline shape

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Summary: *Carte Pisane* (*CP*), the portolan chart known with this name since 19th century, is considered by majority consensus as probably Genoese made and the earliest extant portolan chart of the Mediterranean Sea dated to the late-13th century, in High Middle Ages. This consensus is not yet based on solid certainty. As suggested by the map-reading theory of cartography the content of any map is constituted by two sets of ‘cartographic elements’, the *geometric* and the *thematic*, graphically represented on a material carrier (the vellum in this case), with toponymy being the fundamental element of the thematic set.

A radiocarbon (¹⁴C) analysis of the vellum has recently placed the *CP*’s date between ca. 1170 to ca. 1270, whilst another recent dating based on toponymy proposed *CP* at a later period, in the 14th century, as part (perhaps the earliest, with some doubts concerning the *Crotona* chart) of all the portolan charts of the Late Middle Ages. But what about the date of the second important constituent, i.e. the *CP*’s geometric set, an element as fundamental as toponymy? To answer this question, we concentrate on the *CP Coastline* (*CPC*) in order to investigate the possibility of getting new insights on the *CP* dating question and affine issues. For this, we implement well-known comparative methods, known in geospatial engineering, for analysing the degree of *CPC* closeness or faraway from the actual coastline of the Mediterranean.

The analysis shows a clear and consistent spatial pattern with highest degree of *CPC* closeness in areas of the central and eastern parts of the Mediterranean, seen with north upwards. This spatial resembling recalls the historical importance of these geographical areas during specific periods of the mid High Middle Ages associated, among other issues, with the strong antagonisms for the transition of geopolitical power between the old and new protagonists in that period and those areas. The concomitant historical events combined with the geometric results of the *CPC* analysis indicate as a possible dating of its graphical representation the earlier limit of the time span estimated by the ¹⁴C analysis, or even before. More importantly, however, they shed serious doubt to the *opinio communis* that the *CPC* also dates to the late-13th century, or later, as this period is presumably closer to the *CP* toponymy and the vellum’s date, ignoring in this complicated process the contribution of fundamental geometric cartographic elements, the *CPC*.

Introduction

Carte Pisane (hereafter *CP*)¹ is considered as probably the earliest known extant portolan chart of the Mediterranean Sea (CAMPBELL, 1987),² anonymous, presumably of Genoese origin, from the late-13th century (ca. 1270) according to the *opinio communis*.³ It is thus unique, emblematic and a milestone in the history of maps and cartography. A recent twofold discussion on its dating, re-kindled interest about

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¹ The French name of this originally anonymous portolan chart was given in the late first half of 19th century by the engineer and archaeologist Edme-François Jomard (1777-1862), thanks to its preservation in the map collections of the Bibliothèque nationale de France (BnF) when Jomard served as ‘conservateur administrateur’ in 1838. The Italian name *Carta Pisana* is also widely used in the specialised literature. See BnF, département des Cartes et Plans, CPL GE B-1118 (RES): http://expositions.bnf.fr/marine/grand/por_007.htm and the digital library online Gallica/BnF: <https://gallica.bnf.fr/ark:/12148/btv1b52503226n/f1.item>

² Campbell’s treatise is still a *sine qua non* reference for a consistent and solid all around introduction into the issue of portolan charts, as is also its updating continuously since 2011 special section on portolan charts in his website online since 1996: *Map History / History of Cartography: THE Gateway to the Subject*. Cf. maphistory.info/portolan.html.

³ The chart owned in Pisa at the time of change property. It is interesting to note that both Genoa and Pisa, in almost constant rivalry with Venice, gained important commercial privileges from the Eastern Roman Empire and harvested vital benefits, especially the Genoese; among them the right to settle affluent and politically influencing communities in Constantinople (APPENDIX 4).

the *CP* but increased the doubt about dating and origin, which presented two contradictory ‘new propositions’ for *CP* dating based on the analysis of the *CP toponymy* and on the date of the vellum and other *material* elements of the map. The re-examination of toponymy gave rise to a partial controversy (GAUTIER DALCHÉ, 2001; PUJADES, 2013; CAMPBELL, 2015⁴), as it variously proposed or rejected a later dating of the *CP* to the Late Middle Ages (hereafter LMA), where the set of most portolan charts belong, questioning thus the date accepted by majority consensus. The radiocarbon (¹⁴C) dating of the map's material elements placed *CP* with 95% probability within a time-span of a century, from ca. 1170 to ca. 1270 (HOFMANN et al., 2016), thus shifting the date to an earlier period, in late High Middle Ages (hereafter HMA), namely the late 12th century (to complete the abbreviations of the Middle Ages periods, Early Middle Ages hereafter EMA). Thus, the different dates of the *CP* proposed, the early one by the ¹⁴C dating and the later one by the *CP*'s toponymy are in serious need of re-evaluation, esp. since the other fundamental cartographic element of *CP* has not received the deserved attention.

In this study we attempt to answer these questions based on classical cartographic methodology and practice, according to the map reading theory (e.g. BERTIN, 1967/1983), i.e. concentrating on both parts of the map's content, the *geometric* and the *thematic*. The analysis of the complex structure of the map content is facilitated by its decomposition into its two constituent parts, the geometric and the thematic (APPENDIX 1). The dual nature of any map is a standard concept in cartography but not so familiar to historians of cartography, and decomposition is the supporting tool for the elaboration of the map's content elements, including the geometric elements and among them the *Coastline* (APPENDIX 2), in our case the *CP Coastline* (hereafter *CPC*), equally fundamental in the geometric part as toponymy is in the thematic part.

The core issue of this research is the analysis of the *CPC* shape using modern and now standard comparative methods (APPENDIX 3), with respect to the actual coastline representation of the Mediterranean (hereafter *M*). The results show interesting spatial points, which are related to the degree of closeness of the *CPC* to *M*, and in turn lead to useful historical connotations and relevant correlations. These spatial points are likely related to important events in the HMA that took place in the areas of *CPC* most close to *M*, offering in turn new insights about the actual date of the *CPC* formation, in a period even earlier than that of the ¹⁴C analysis. This dating differs from that of toponymy, which could possibly be related to a later time, and of course that of the vellum and other material elements of the map. Differentiation in dating seems not to be the case for the entire corpus of portolan charts that appeared after *CP* in the LMA and later, since the date of their two content parts (*geometric and thematic*) is mostly converging. Therefore, the significant results of the *CPC* analysis and the historical connotations suggest that the *CP*'s formation fulfilled an immediate need in the period around the mid 12th century. This was a transition period of fast and complete reversal of the balance of power in the Mediterranean, when a number of various naval powers from different cultural backgrounds and legacy, interacted among them so as to maintain and support their political, military and territorial lead or supremacy in seafaring and trade in certain coastal areas where they had special interests (APPENDIX 4).

The spatial points of *CPC* analysis

In order to assess how close the *CPC* is to *M*, the well-known comparative ‘cartometric’ method (e.g. MALING, 1989) offers answers, as it allows the detection of locations of higher *CPC* closeness. These places reasonably reflect historical connotations about their particular importance at specific times in history, the same or close to the time of *CPC* graphical construction. But what is really the ‘time’ reference of the *CPC* represented in *CP*? If it is plausible that each map is constructed from ‘parts’ (CAMPBELL, 1987), then a possible date could be the period when the assembly of the ‘parts’ was transformed

⁴ Campbell explained the apparent toponymic anomalies, and set out a wide range of other arguments, to confirm the Carte Pisane's very early dating. Cf. <http://www.maphistory.info/CartePisaneMenu.html>.

in a unique coastline. The way the *CPC* construction took place belongs to the cognitive contents and technical practices of (at least) the Late Antiquity, i.e. locally *acquired* ‘parts’ properly assembled are then unified in a form necessary for depiction on a map (APPENDIX 2).⁵

Leaving to historical experts the discussion about the shape of the local coastal trends *acquired* with any mode of acquisition the time when it is likely to have been made over the previous centuries with all possible updates and upgrades, we attempt here a comparative analysis aiming at localising areas of significant closeness of *CPC* as finally drawn on *CP* to *M*. Indeed, the results provided ‘signals’ of the *CPC* closeness, in terms of properly designed indices of spatial proximity or faraway, and the implemented cartometric method proved to be independent of some operational choices that should be made, concerning, e.g., (see also LANMAN, 1987),⁶ the modern map model of *M* used for assisting the process of the comparative analysis. This is assured when ‘signals’ of the same analogy are obtained whatever the used model is. Having thus tested the practical insignificance of the model used in affecting the indices of *CPC* spatial proximity and faraway, we opted for a typical Mercator projection in which *M* is represented. Then, the comparison process followed standard coordinate transformation, here selected the *affine* (APPENDIX 3), keeping the *CPC* unaltered. The numerical results obtained, in terms of spatial residuals, were then graphically visualised in the friendly form of proportionally varying circular symbols. In order to make them easily readable, we ordered the results in quantitative classes of magnitude and then ‘translated’ them into qualitative symbolic indices describing proportionally the spatial deviations of *CPC* locations from the homologous ones on *M*.

Data and elaboration method

The available digital image file of *CP* is used to create a new file,⁷ deleting all other depicted elements except the *CPC*. This new image file is taken as the control representation onto which a modern *M* is fitted optimally implementing proper coordinate transformation, here the *affine*. Result of the transformation is the computation of new coordinates for the modern map of *M* satisfying the transformation properties and the best fitting into the *CPC*. Thus, locations of the *CPC* resemble *M* if are, in principle, better *acquired* and better graphically represented, whilst other remain distant, obviously if not set properly in the mapping process. The locations with higher degree of *CPC* closeness coincide with coastline places of historical importance,⁸ mostly in the period between the second half of the 9th century to the second half of the 12th century (APPENDIX 4).

⁵ The term *acquire* means here (and hereafter in the text) the modality of any sort of acquisition/acquiring (i.e. amassing, collecting, gaining, getting, taking, even memorising) of spatial information useful in any process of representation of spatial geometric and/or thematic entities, either of mental or other character assisted by measurements. Campbell, e.g., discusses the issue of *mental mapping* (CAMPBELL, 2016).

⁶ In LANMAN (1987), with the acknowledged contribution of John P. Snyder’s expertise on issues related to map projections, the insignificant influence of the choice of quadrature-type map projection is discussed (plate carrée/normal Mercator) for relatively small geographical areas, as it is the Mediterranean Sea, compared to the dimensions of the globe, far from the pole and the equator, especially when the map scale is small, as is the case with *CP*, varying between ca. 1:4,000,000 and 1:4,500,000 with a few bigger scale exceptions at the north and east ends of the *CPC*, according to the *CPC* baseline measurements given by NORDENSKIÖLD (1897).

⁷ File ‘Carte Pisane Jomard.png’ in public domain: commons.wikimedia.org/wiki/File:Carte_Pisane_Jomard.png. For interactive detailed view see the site of BnF http://expositions.bnf.fr/marine/grand/por_007.htm. Also Gallica/BnF on line: <https://gallica.bnf.fr/ark:/12148/btv1b52503226n/f1.item>.

⁸ The coastline places highlighted on the *CP* are intimately related to the strong and evolving antagonisms between old and new powers for occupation of these locations as critical western outposts for the Byzantines and as challenging stakes of power for the Normans of Sicily; they both aimed at securing, advancing and exercising geopolitical influence, military control and mobility, safe navigation and maritime trade. In this spatial and historical setting, the Genoese, the presumed *CP* makers, were very agile and skilfully interactive with both the major parties involved in the contested areas, those with the higher degree of *CPC* closeness to *M*. In this light, no one could exclude placing the *CPC* dating in a period even earlier than that of the earlier one indicated by the ¹⁴C estimation.

Processing steps

The first step in our analysis was to identify locations on *CPC*, easily recognisable on *M*. By putting under comparison *M* with the *CPC*, described respectively by two homologous sets of coordinates, a sufficiently adequate number of control points can be selected on the *CPC* (Fig. 1, left) as easily recognised on *M* as homologous points.

The process continues with *affine* transformation involving the two sets of coordinates, from which the six unknown parameters of the transformation are determined. The final result obtained by this process is the set of the *residuals* describing the degree of *spatial separations* of the *estimated* coordinates of the reference points derived after the best-fitting transformation implementing the well-known *Least Squares Adjustment* method (APPENDIX 3).

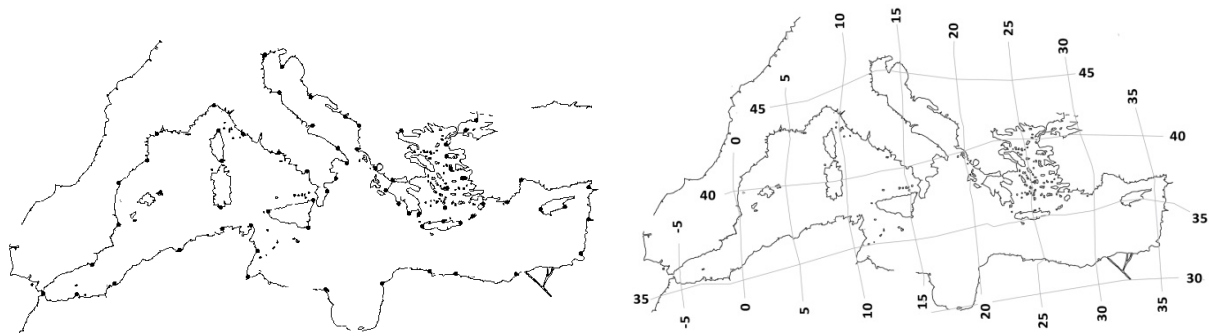


Figure 1: Left: The distribution of the reference points in the *CPC*. Right: To the apparently ‘projectionless’ *CP* portolan chart a generalised georeferenced graticule can be indicatively assigned a posteriori, illustrating the deformation induced after an ‘exact fitting’ biasing into spatial coincidence the two sets of control points (APPENDIX 3). Here, the exact fitting is the result of the *finite elements method* transformation (BOUTOURA & LIVIERATOS, 2006)

Result of the coordinate transformation process is a numerical list of residuals describing for each reference point the degree of spatial proximity to and faraway of *CPC* from *M*. The results obtained are in general agreement with those given for the *CP* by others (NICOLAI, 2016) as far as the standard error is concerned, even if the data used in our study are less and the process much simpler, but producing nevertheless the same ‘signal’. Grouping then the residuals in five qualitative/quantitative classes for the *nearest* and *nearer* fit indicating proximity and *near*, *far* and *farther* indicating larger separation, we obtain the relevant spatial distribution in Figs. 2 to 4.

For the depiction of the residuals we avoided visualising numerically the obtained values generalising instead in quantitative proportional classes illustrated by point symbols, e.g. circles of varying radius, representing the degree of separation, because this type of depiction rather than with explicit numerical values is easier perceived by the unfamiliar (Tab. 1). This visualisation method is standard and widespread, with strong communication capacity especially for the comparison of proportional results (BERTIN, 1967/1983).

Spatial separation	Proximal		Distant		
Qualitative/Quantitative classes of closeness of the fit	●	●	●	●	●
Attribute of closeness of the fit	<i>nearest</i>	<i>nearer</i>	<i>near</i>	<i>far</i>	<i>farther</i>

Table 1. The symbolic representation of the fitting residuals distributed in five thematic classes from *nearest* proximity to *farther* distant separation.

The results of the *CPC* spatial analysis

The highest degree of *CPC* closeness to *M* (Fig. 2) correspond to two areas of major importance, one in central Mediterranean, from Dyrrhachium to the straits connecting the Adriatic with the Ionian Sea (now called Strait of Otranto) separating the east coasts of the Salentine Peninsula in Apulia from the opposite south Adriatic coasts, and the other in Crete and the eastern part of the Aegean Sea.

The first is a key spatial spot of *CPC* closeness to *M* related to the geostrategic dynamics for the possession of South Italy during the Byzantine and Norman confrontation that lasted from the mid-11th to late-12th century, for which ANNA COMNENA (1148) relates that a ‘coastal map’ made by her father was used by the Byzantine fleet in the waters of Dyrrhachium against the Normans in 1108. The second area of nearest proximity of *CPC* is the sea belt of the eastern Aegean Sea and the east and west endpoints of Crete corresponding to navigation routes most familiar to the Byzantines, since the early times of their supremacy in the Mediterranean as noted in 10th century by the byzantine emperor Constantine VII (HUXLEY, 1976). The same navigation route was also familiar to the Genoese even before developing settlements in the big islands of the eastern Aegean, e.g. Chios and Lesbos (APPENDIX 4).

The proximity pattern of the *CPC* begins to make even more sense when to the attribute of the *nearest* closeness is added that of the *nearer* (Tab. 1). The general pattern of proximity to *M* thus-formed (Fig. 3) concentrates on the eastern coastline of Apulia, Calabria and Sicily, the Illyrian and Ionian coasts, the arc of the south endpoints of Peloponnese to Crete and Rhodes, and following the north-eastern direction on the islands of Samos, Chios, Lesbos and Tenedos close to the entrance of the Dardanelles, through which the sailing to and from Constantinople was (and still is) a ‘canal-like’ navigation.

All other *CPC* locations of the *near*, *far* and *farther* attribute type (Tab. 1) are distant from *M*, as depicted in grey dots together with all the locations of proximity (black dots) in Fig. 4. The distant separations of the *CPC* are the locations along the western and eastern Mediterranean coasts, the African coasts, the north Aegean and particularly the northern Adriatic. Interestingly, in *CPC* the spatial locations of important centres are rather poorly set, e.g. Venice, Alexandria, Thessalonica, Marseille, and the Catalan–Balearic coasts as well as Genoa and the shores of the Tyrrhenian Sea. This means that the *CPC* makers were less concentrated on these areas, either at the time of the *CPC* formation or earlier.

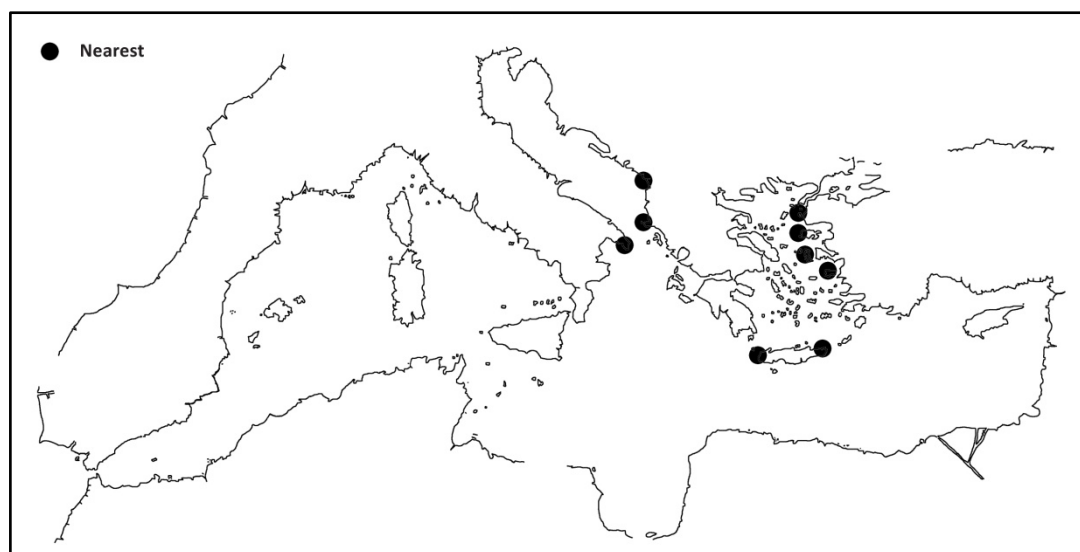


Figure 2. The areas of *nearest* proximity *CPC* best fit to actual coastline *M*.

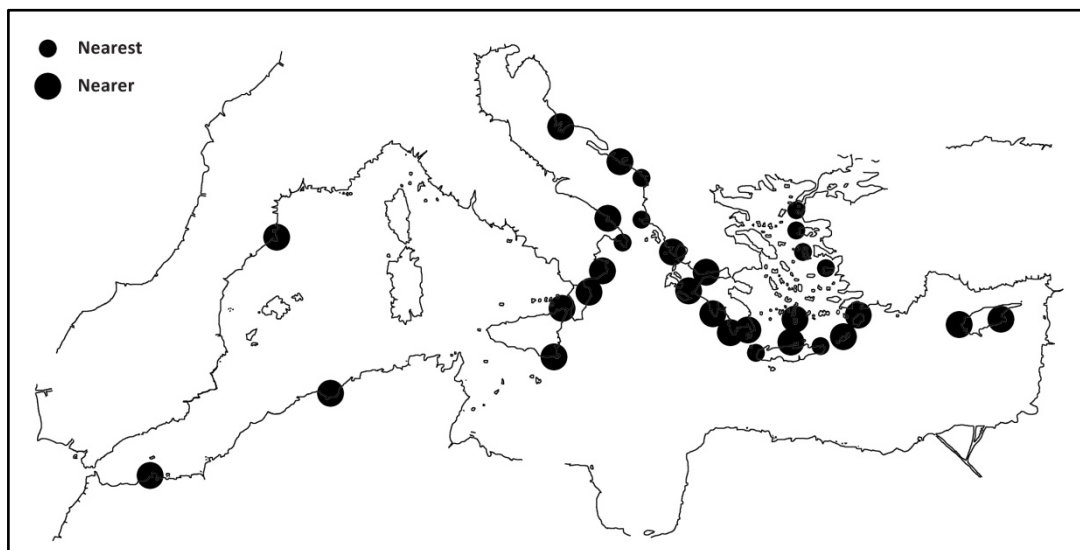


Figure 3. The areas of *nearest* and *nearer* proximity CPC best fit to actual coastline *M*.

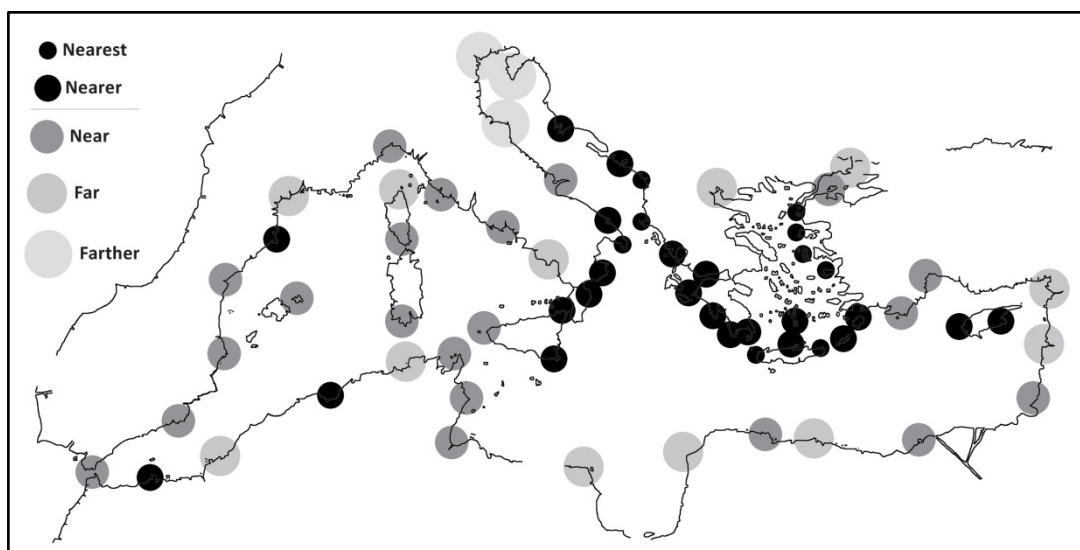


Figure 4. The distribution of the *near*, *far* and *farther* separation of the CPC from *M* (grey dots) in combination with the *nearest* and *nearer* proximity of the CPC to *M* (black dots) completes the overall setting of the CPC fit to *M*.

The results of CPC analysis and the historical context

The results of the CPC analysis and the areas of major closeness to *M* show a major conformity with the areas where all the principal naval forces of the Mediterranean (Byzantine, Arab, Latin and Norman) were active at the same area and at the same period of time, from the early to the mid HMA among all powers, of which only the Byzantines had a previous long lasting presence there (APPENDIX 4), due to their possessions and geopolitical interest in ‘Byzantine Italy’ and in the west and east coasts of south Adriatic (Fig. 5).

Despite the historically well-known strong presence of the Byzantines during HMA in the areas where the CPC presents the higher proximity to *M*, it is intriguing how in modern literature even a hint at a possible Byzantine trace of using early portolan charts is met with disbelief or disapproval.⁹ At the risk

⁹ See, e.g., the subtle but derogatory comment by EDSON (2007) on the explicit and detailed reference made by Anna Comnena in her *Alexiad* about the use of a ‘coastal map’ in 1108: *If we can take Anna’s description at face value, this would be the earliest description of a chart and accompanying portolan* (cf. p. 42).

of criticism for ‘national or cultural bias’, the results obtained from the *CPC* closeness to *M* analysis are self-evident: the historical connotations strongly suggest as highly possible a direct or indirect Byzantine involvement in the *CP* story in the mid HMA, at a time of their intimate interactions with the Genoese (APPENDIX 4). The earlier (ca. 1170) and later (ca. 1270) date limits indicated by the *CP* ¹⁴C dating computation correspond to important turning-point periods of Byzantium,¹⁰ in which the Byzantines encouraged most privileged relations with the Genoese. Only the earlier ¹⁴C dating limit, however, is highly relevant to the strong geopolitical conflicting interests in South Italy and the opposite Adriatic coasts, the areas clearly indicated by the *CPC* proximity analysis.

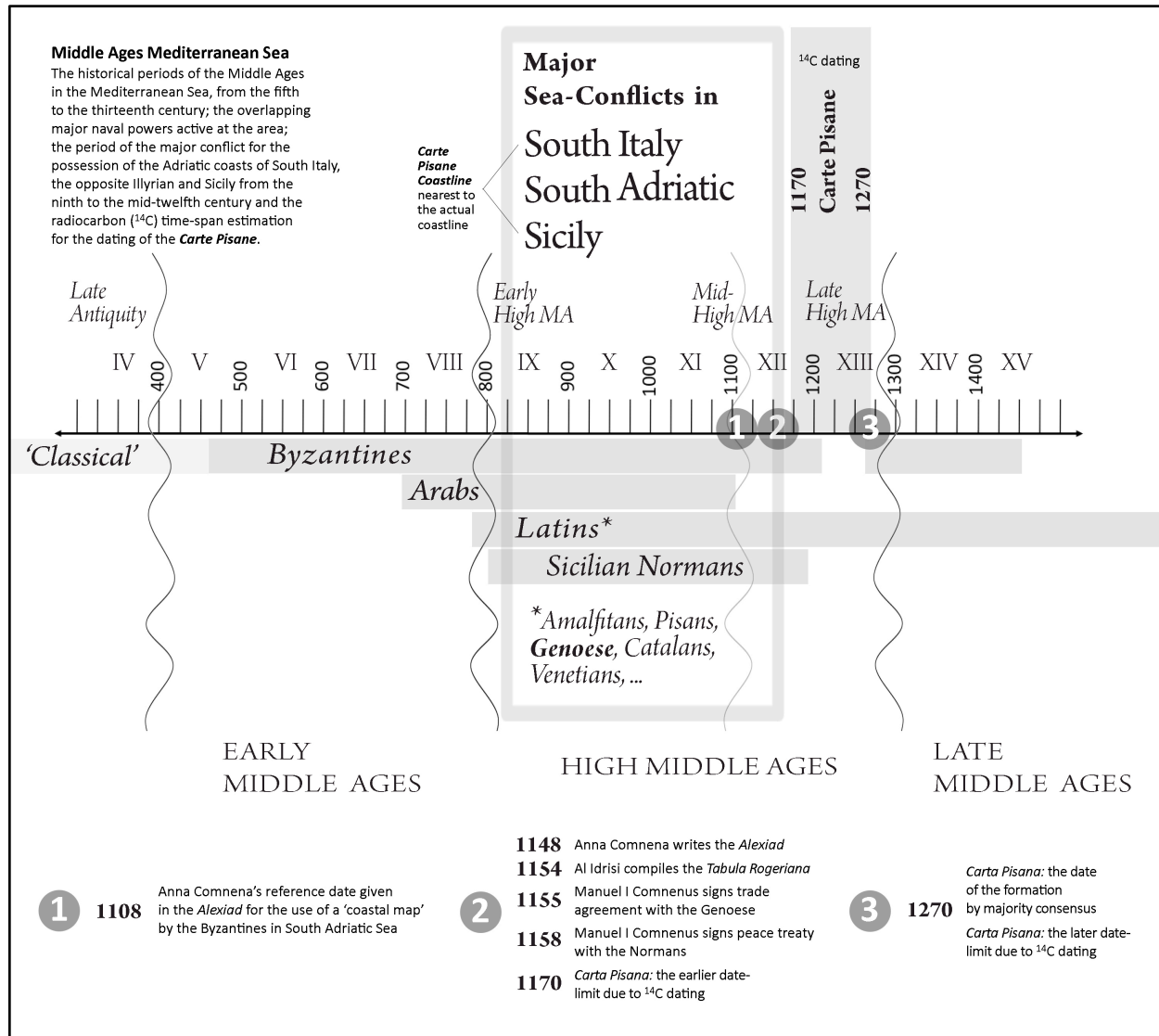


Figure 5. The Middle Ages Mediterranean Sea: the historical periods of the Middle Ages in the Mediterranean Sea, from the 5th to the 13th centuries; the overlapping major naval powers active at the area; the period of the major conflict for the possession of the Adriatic coasts of South Italy, the opposite Illyrian and Sicily from the 9th to the mid-12th century; the radiocarbon (¹⁴C) time-span estimation for the dating of the *CP* and the relevant major events of mid-HMA in early-12th century.

The close relations between Genoa and Constantinople is distinguished into two historical phases (ORIGONE, 2001): the first phase covers the period after the First Crusade (1094-1097) to the Fourth Crusade (1204); and the much longer second phase the period from 1261 to the Fall of Constantinople in 1453 during which the areas of *CPC* higher proximity to *M* do not play a major role (APPENDIX 4).

¹⁰ The earlier limit to the late reign period of emperor Manuel I Comnenus ended in 1180 and the later to the early reign period of the Palaeologan imperial dynasty that started in 1262.

The areas indicated by the *CPC* analysis evidently reflect the Byzantine and Genoese relations during the first phase, and therefore argue for a *CPC* dating in the mid-HMA, even before ca. 1170 the earlier date limit estimated by the ^{14}C dating.

But, more than that, the *CPC* analysis also reflects the higher degree of accordance of the actual values of latitudes with the ones given by Ptolemy in his *Geographia* for exactly the same specific areas, as combined with the smoothest pattern of the relevant longitude differences, after eliminating the systematic effects in Ptolemy's positioning values (LIVIERATOS, 2006; TSORLINI, 2011).¹¹ This strong geospatial affinity of the higher degree of *CPC* proximity to *M* with the higher degree of closeness given by Ptolemy's coordinate positioning with respect to the actual counterpart is strong evidence of the importance that only those same areas had enjoyed in the Late Antiquity, as far as the representation of the Mediterranean is concerned, and recall the 'Classical' trace in the medieval shaping of *CPC* (APPENDIX 4).

Conclusion

In this paper our attempt has been to investigate whether the results of the analysis about the closeness of the *CPC* to *M* could provide some new insight into the still open questions about the *CP*. Focusing on the geometric element of the *CPC*, the results of the analysis corroborate that:

- a) *CPC* locations of good closeness to *M* definitively exist;
- b) Their degree of closeness is practically independent of the analytical cartometric method used; and
- c) The identified locations of closeness correspond to areas of specific historical connotations at important periods of the HMA, around the mid-12th century, in which the presumed Genoese *CP* producers (or associated to them other Latin mariners) were actively involved and interacted with the major powers of the period in those areas, especially those which dominated these areas for a long time (APPENDIX 4).

We also proposed that the thematic and geometric contents of a map (APPENDIX 1) need not be of the same date, an axiom commonly perceived in cartographic research and practice and obviously valid for *CP* too. The dating of the origin of the geometric cartographic elements, as it is the coastline representation (APPENDIX 2), does not necessarily go hand in hand with the dating of the thematic cartographic elements (e.g. toponymy) which possibly follows, since the geometric data used for the shaping of the coastline at a certain date should be based on data collections acquired and elaborated at earlier times. This possibility is reflected into the sea routes reported in *Liber de existencia riveriarum...* (GAUTIER DALCHÉ, 1995) dated ca. 1200, in that the geometric data of sea-traverse type (Fig. 6) could have derived from different collections of sea-routes data in different times, or computed from different routes, as the variation of the nautical mile-to-kilometre ratios demonstrates explicitly (BALLETTI et al, 2017). The coastline-focused geometric analysis applied to the *CPC* with respect to *M* showed clearly that the *CPC*'s locations of its nearest and nearer proximity to *M* highlight mostly the areas and times of Byzantine and Norman antagonisms in the Adriatic coasts of South Italy, in the opposite Illyrian coasts and Sicily, where also the Genoese developed strong commercial naval mobility, during the transitional period from mid 11th century to the Fourth Crusade (APPENDIX 4). In this perspective, all main historical clues enveloping the question of *CP* origin and as regards *CPC* need further research with the support of the available tools of modern digital geospatial analysis. Especially those clues of the pre-Fourth Crusade period of the Middle Ages, e.g.: a) the remote 'Classical' track and its Roman and Byzantine heirs to the late-EMA; b) the 'unity' track of the Mediterranean world including the Byzantines, the Arabs and the Latin naval communities to the 11th century; and c) the interaction of Byzantium with the Sicilian Normans in the Adriatic coasts of South Italy, intersected imposingly by the Genoese in the first

¹¹ The authors illustrate the results after having applied deformation analyses and eliminated all the systematic part of the differences of Ptolemy's longitude and latitude values from the corresponding actual longitude and latitude values in the Mediterranean.

phase of their relations with Constantinople in the 12th century. In all these hints it is worth noticing that Byzantium is Ariadnes' thread, the only common denominator of the whole period from the early to the mid-HMA (RONCHEY, 2006).

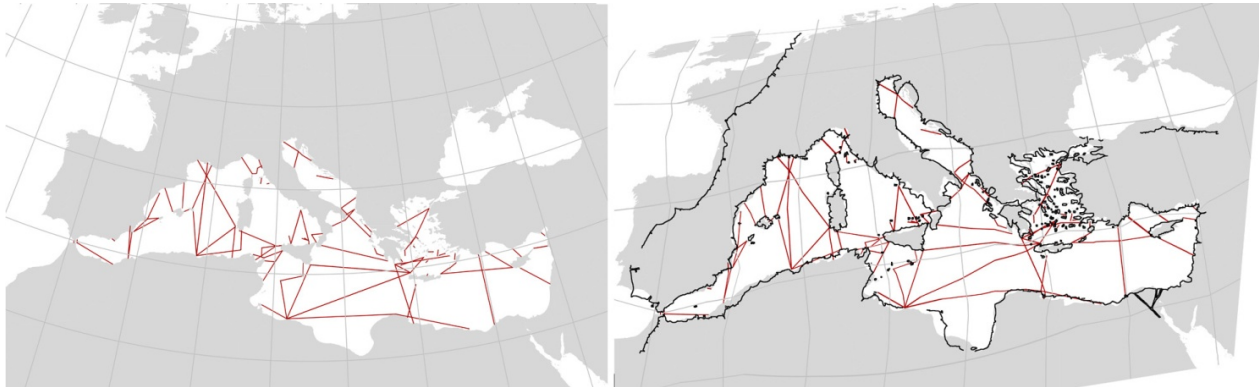


Figure 6. The spatial representation of the navigation baselines reported in *Liber de existencia...* (ca. 1200). Left: the graphical representation on a modern map, by Jean-Gabriel Coste, of the sea navigation routes, included in Gautier Dalché's reference publication (1995). Right: the *finite element method* (APPENDIX 3) exact fitting of Coste's representation onto the *CPC* representation analysed here.

Suffice it to say that tests of cartometric analysis implemented in later portolan charts, as is, e.g., Dulcert's 1339 representation (LIVIERATOS, 2006) and later, showed a different coastline pattern indicating that the LMA portolan charts as far as coastline aspects are concerned, belong to another historical period of rather improved cartographic knowhow. It is evident that the 14th century portolan charts and the later ones represent an advancement of the geometric content in terms of coastline shaping, indicating the possible use of better *acquired* data and better elaboration techniques, as demanded by geometry (e.g. TOBLER, 2007; ALVES GASPAS, 2008).

The missing of concrete source-data about the origin of *CP* and/or its eventually earlier reference models makes rather futile at present the search for a definite and integrated answer to the enigmatic question about the origin of portolan charts. This requires a step-by-step study and the map content decomposition approach (APPENDIX 1) together with supporting contributions from history, because these may function as guiding principles for the reduction of the many possible solutions of the portolan chart problem.¹² But also perhaps cultural partiality is to be resisted especially when dealing with the role of all major historical players, their historical weight, their explicit and implicit relations, and the changing balance of power at the period and before the estimated time of the *CPC* construction.

The discussion on the origin and evolution of the coastline representation of portolan charts from 14th century onwards should be differentiated from the earlier *CPC*, since the newer representations look fitting best the overall *M*, without focussing on areas with particular historical connotations, as in *CPC*.

The partition of historical continuity in the study of the history of cartography and maps (including the origin and evolution of portolan charts) according to the specialty assignment of the researches dealing with the issue, the assignment concentrated only on a specific period of History (as it is the stereotype in traditional historical research), risks to create a different type of 'sense of belonging' among the researchers, now not related to 'national or cultural' reference but depending on their specialty assignment in only one specific historical period; this 'limited view' makes often researchers ignoring or underestimating historical periods other than those of their own research focusing on the specific period they are dealing with. The modern 'digital interfaces' advancing now in Humanities (cf. Digital Humanities)

¹² Quite the opposite is the case of Ptolemaic origin maps, where geographical coordinates in Ptolemy's *Geographia* are given to points, producing straightforward well-defined results, namely a directly and univocally computable and easily represented coastline. Examples of the two approaches concerning the portolan charts and Ptolemy's maps related to the geometric content of early maps are given by LIVIERATOS (2006).

seem to give the possibility for a new unified view of history of cartography and maps without the partitioning in tight historical periods, sometimes ‘sealed’ and cancelling historical continuity, blurring the view of a natural continuum in the evolution of cartography.

It is, finally, worth noticing that the fast evolving Digital Humanities look to be a modern privileged field for the meeting of issues of historical cartographic interest. Among them, those related to *CP* and portolan charts in *sensu lato*, look to be better approached in a ‘unified field of historical knowledge’, associated with the established cartographic discipline and the modern advancements in geospatial engineering. The scientific and technological backing of modern cartography offers the necessary analytical tools for investigating the duality of map content especially the geometric part, not yet extensively approached in the research about historical maps (LIVIERATOS, 2016). In this context, the revisiting, with a new view, of relevant historical sources and specialised literature should be necessary, in the context of Digital Humanities, for the strengthening of the quest for synthetic answers still needed concerning the origin and dating of *Carte Pisane*, the oldest extant example of the fascinating cartographic typology of portolan charts.

Acknowledgements

In a brief personal discussion, H el ene Ahrweiler (2017) insisted in pointing out, as key issue in this research, the explicit reference of the use of a ‘coastal map’ in 1108, evidently of a nautical chart type, made by Anna Comnena (1148) in her *Alexiad*, XIII (VII). Tony Campbell (History of portolan charts) read the final version of the paper (2018) and offered suggestions sharing comments and inspiring ideas. Andrea Nanetti (Medieval and Renaissance studies) read the paper (2017-2018) and made constructive comments. Long discussions with Yannis Tzifopoulos (Classics) about important epistemological and methodological issues in Humanities related to this research (2016-2018) improved the content and the structure of the paper.

APPENDIX 1 – *Map content duality and decomposition*

The map content of whatever cartographic typology and date is the synthesis of two major constituent sets of cartographic elements: the *geometric* and the *thematic*, whose synthesis provides the final complete image of a map.¹³ Among all supporting material of the two sets, fundamental for the geometric set is the *coastline* element separating land from sea, the line chiefly contributing to the overall shaping of any map; and for the thematic set *toponymy*. In the course of history, both sets of cartographic elements played an important role in the evolution of maps, obviously in association with other cartographic elements belonging to the two sets.

Important for the research on early cartography, as is the case of *CP*, is the issue of studying the map by *decomposing* its content into its two sets, which, albeit common practice in map reading and analysis by cartographers, is not always familiar to non-cartographers mainly because of cultural reasons.¹⁴ In any case, decomposition can be the key for better analysing and interpreting the portolan charts, given the prevailing uncertainty and contradiction among experts about their origin, evolution and affinities in the course of their history.

A decomposition approach in the study of *CP* may provide a new outlook and understanding of the subject of its dating, so far postulated at the late 13th century. In fact, as it is common practice in cartogra-

¹³ According to modern standard cartographic definitions, maps with emphasis on the geometric content are called ‘reference maps’, maps with emphasis on the thematic content are called ‘thematic maps’ and maps with emphasis on both the geometric and thematic content are called ‘special-purpose maps’ (e.g. BREWER, 2008). According to this classification, the portolan charts may, e.g., be termed ‘special-purpose maps’.

¹⁴ In general terms, the geometric set of cartographic elements is culturally closer to geospatial sciences, technology and engineering, whilst the thematic concerns mostly humanities, social sciences, arts and other relevant disciplines related to the interaction between human and natural environment. The rapprochement of science and technology with humanities is thus the key for rethinking, re-organising and re-approaching the issue and a challenge for Digital Humanities.

phy, and there is no compelling reason to have been otherwise in the past, the synthesis of the *CP* geometric elements, e.g. the *CPC*, with its thematic ones produced the map in its final form, which apparently took place at a certain time. This, however, does not mean that the date of origin of the geometric elements, e.g. the *CPC*, coincides necessarily with the date of the thematic elements, or for that matter with the date of the final map production. As a rule of thumb, and notwithstanding that this may be the case, the geometric elements available and used at the time of synthesis must surely have been generated and elaborated in an earlier time, but how much earlier must perforce on present evidence remain an open question.

Therefore, when dating examines and analyses only the thematic elements, e.g. toponymy, things become relatively straightforward, as the parameters involved are affined to fields of knowledge with broader cultural diffusion, related mainly to humanities, where the evidence is by far richer and more familiar or easier approachable to many. In contrast, the geometric elements and coastline representation present more challenges, as they demand special knowledge and not as widely diffused. Consequently, dating the geometric and thematic elements of any map need not at all converge to a common date perforce.¹⁵ Ambiguity also blurs the date of the vellum used as the material carrier of all cartographic elements represented in *CP*, because its actual production and storage could have preceded its cartographic use. If the recent *CP* ¹⁴C date is definitive, no one can then exclude the possibility that the *CPC* reflects relevant geometry-borne models acquired and used in the Mediterranean even earlier than 1170, in a historical period that witnessed strong antagonisms and transition of geopolitical powers for sovereignty over the Adriatic coasts of South Italy and surroundings.

APPENDIX 2 – *Forming the shape of the coastline*

The coastline is the most representative element of the geometric content of maps, especially of the nautical typology in which the portolan charts belong. A good fit of a coastline representation to its actual shape means a ‘special care’ and knowhow in acquiring and processing the relevant spatial data necessary for assembling and representation. This ‘special care’ reflects the navigational importance of the coastline’s geographical area to be represented either for commercial purposes or because of some exceptional geopolitical issues, which evolved along the coastlines of that area and implicated the naval interests of powers operating there at the time.

As it is known that the ancient Mediterranean civilisations were technically capable in seafaring and navigation (ARNAUD, 2005), their perception of the coastline topography was based on the elaboration of the data obtained from the known point-positioning practices based on observations of the sun and the stellar firmament in relation with time and angular measurements, using appropriate instruments (e.g. DE SOLLA PRICE, 1969; WRIGHT, 2000). This ancient knowhow (TALBERT, 2008) was also combined with the experience of estimating the distances of navigation routes in a variety of modes including time duration of sailing and empirical measurements of lengths as used in ancient seafaring (ARNAUD, 1993; CARASSO, 1994; VELLA, 2004).

Descriptive examples for the most used navigation routes in the Mediterranean are common in literature concerning areas of major importance from Antiquity to the LMA. Especially in the important area of central Mediterranean, textual or virtual navigation descriptions are important to familiarize with mental representations of the coastlines, as NANETTI (2011) has suggested by focussing, e.g., on the Peloponnese in order to underline its strategic position as the interspace between the Aegean Sea and the Ionian–Adriatic Seas together with the adjacent coasts, as the key issue for the naval powers to assure

¹⁵ In modern cartography it is standardised to appear in the properly set map-legend the eventual different date references of the geometric and of the thematic cartographic elements represented in the finalised map. These dates could precede the date of the final map production.

their own military or commercial *thalassocracy*, an ‘eternal stake’ in the struggle for dominance from Early Antiquity (MORTON, 2001) to the LMA.

Later, the old expertise in using the angular directions of the winds were enhanced with the addition of a new instrument, the compass, and improved the process of the determination and graphic representation of the coastline shapes. It is thus not at all surprising to have coastline representations for the Mediterranean of the *CP* type. Obviously, the data acquired locally were assembled in one image, considering the coastal spatial acquisition possibilities of antiquity including positioning and its intuitive adjustment (WOODWARD, 1999), with all the reasonably expected distortions and deformations (CAMPBELL, 1987).¹⁶

The possibility of the *CPC* construction by assembling the locally *acquired* parts of the coasts into a unified coastline of the Mediterranean was a practice belonging to the cognitive content of (at least) the Late Antiquity. For astronomical point positioning was more than enough to provide, by a sort of ‘sewing’ procedure, the tools for assembling the local spatial *acquisition* of the many coastline-parts (possibly made in different times) into a unified coastline end result represented in a ‘bidimensional’ graphical space (TALBERT, 2008) as in the *CPC*.¹⁷ This unified coastline representation possibly underwent subsequent empirical adjustments, as suggested by WOODWARD (1987),¹⁸ obviously according to practical needs related to particular multitasking interests of navigation. The procedures for the acquisition of the coastlines by point-positioning even if known from antiquity, as part and parcel of the point-positioning knowhow,¹⁹ are normally not explicitly reported or referenced in the historical sources, general or specialised, and thus not transferred into historiography as regards at least the EMA and HMA. The mapping procedures of the past, concerning, e.g., a coastline, is not part of the corpus of early historical sources, as is also, more or less, the case nowadays. They are ignored in the narrative of historical events as ‘tedious technicalities’ or matters of specialized military affairs and are considered as such by the majority of historians who believe that those ‘technicalities’ do not deserve special attention to be integrated in mainstream historiography. But for a modern specialist of the evolution of *acquiring* spatial information (including mental), of geodesy and surveying, of point-positioning with the use of the stars, of the angular and distance measurements and time, including relevant metrology, there is no conceptual mystery about the existence of a coastline depiction in the oldest extant portolan chart; its existence is almost axiomatic, and thus, there is no puzzle to be solved as to how the *CPC* saw the light of day, taking into account the general adventures of Mediterranean history. The intriguing question which makes much more sense is how close the *CP*’s coastline is to the real shape and why.

¹⁶ During the multi-centuries long history of seafarer, the Phoenician, Greek and Roman sailors collected all the notices of positions, directions, diurnal distances of the particular Mediterranean coasts, which were included in the ancient *Peripli* that appeared from the 5th century BCE to CE 1st century. A last *Periplus*, perhaps from the time of Augustus and in use until the Byzantine 5th century, was the *Stadiasmus* that gave distances no longer in days and nights of navigation but in lengths measured in *stadia* for the Mediterranean and the Black Sea (referred in Greek as the *Σταδιασμός ἤτοι Περίπλους της Μεγάλης Θαλάσσης*, *Stadiasmus namely Periplus of the Great Sea*). The content of ancient *Peripli* was transmitted to the Middle Ages through the never-ending commercial mobility between the various banks of the Mediterranean, and all this knowledge converged in the first *portolans* and in the first medieval nautical charts (MEDAS, 2008; 2010).

¹⁷ For an interesting ‘revising’ discussion on the relevant ‘bidimensional’ geospatial perception, in Antiquity, see TALBERT (2008) who wanders about earlier proposed ‘unidimensional’ views still supported in literature (e.g. JANNI, 1984).

¹⁸ D. Woodward’s text in CAMPBELL (1987), pp. 387-388.

¹⁹ Typical examples of the coastline representation by in-situ *acquiring* of spatial information as a technical part of the seafarer, which are often called today ‘coastal hydrography’ and remained unaltered through the ages as most techniques of navigating expertise, can be seen in the folders (*recueils*) of the 18th century Bourguignon d’Anville’s manuscript archives, kept in the collections of Bibliothèque nationale de France; the folders are full with quantitative and qualitative data field-sketches (*croquis*) of the coastline surveys (the modern word of *acquiring* and representing local spatial data) in the Mediterranean, the Aegean and other seas.

If a method exists capable to offer the possibility to detect the closeness of the antique coastline graphic representation, in a *global* or *local* sense,²⁰ then some conclusions can certainly be drawn on the quality of the coastal spatial *acquiring* implemented at the places of better closeness. And obviously the conclusion about better ‘spatial knowledge’ opens a discussion on the historical importance of the particular place and the date, which demanded such better endeavour. It is then reasonable to expect that the results and the data of these *acquisitions* of spatial information were deposited in archives at centres of ‘strong naval reference’ and presumably kept privy for security reasons. Those who had access to these archives and were capable to understand and skillfully elaborate were usually related to practical multi-tasking and multipurpose seafaring and less to scholarly research; and they could derive new data at the same place or elsewhere in Mediterranean, thanks to the specialized interest and mobility of the seafarer, thus enriching the archival deposits with new and updated data that could facilitate the graphical representations utilized for the making and use of nautical maps. The real questions that arise are: a) who made the original *acquirings* of information; b) where the data were accumulated; c) who had access to take advantage of the data in order to develop end products and distribute them appropriately. Perhaps answers to these questions and especially access to *acquired* spatial data archives was probably the case of the Genoese and associates, or of some others before them, in relationship with the *CP* and the *CPC*.

APPENDIX 3 – *Coordinate transformations*

Three most commonly used transformations of two sets of coordinates for a ‘best-fitting’ process in comparative analysis are: the *similarity*, the *affine* and the *second order polynomial* characterised by specific properties and some practical choice criteria (BOUTOURA & LIVIERATOS, 2006). The transformation allows the two sets of coordinates, in one-to-one correspondence, under the fitting process (e.g. the *CPC* and the *M* homologous coordinates) to provide statistically a number of initially unknown parameters, according to the choice of transformation, e.g., four parameters for the *similarity*, six for the *affine* and twelve for the *second order polynomial*. The properties and criteria of using these transformations are in summary:

- a) *Similarity* transformation conserves shapes (angular features) under a uniform (global) rotation and a unique (isotropic, i.e. equal in all directions) scale change allowing conformality, followed by a displacement defined by two uniform shifts; the criteria for the choice of similarity transformation are: uniform scale coordinate sets; and the scale might differ between the sets.
- b) *Affine* transformation, followed in this analysis, keeps parallel lines parallel; not necessarily preserving the angles between lines or distances between points on straight line; it is expressed by shape and scale changes in two intersecting directions and a displacement; the criteria for the choice of affine transformation are: at least one of the coordinate sets might have non-uniform scale.
- c) *Second order polynomial* transformation conserves the topology of the setting and changes the geometry through displacement, i.e. a rotation and variable scale alteration in curved directions; the criteria for the choice of second order polynomial transformation are: one of the coordinate sets has worse or unknown geometry compared to the other set.

The reason of selecting the *affine* transformation for the best-fitting of *M* to the *CPC* is because it ‘takes-care’ of six systematic parameters in the transformation, namely two rotations respectively along the reference (NS-WE) directions of the orthogonal coordinate system, thus allowing a best skewing of the reference directions, and also two scale-factors respectively along the reference directions and two orthogonal shifts of the origin of the reference directions.

²⁰ The terms *global* and *local* are used here in the geodetic meaning (see any standard textbook of Geodesy, e.g. VANIČEK & KRAKIWSKY, 1986).

By putting under comparison M with the CPC , described respectively by the sets of coordinates x_M, y_M and x_{CP}, y_{CP} , the sufficiently adequate number of i ($i=1, 2, \dots$) control points $(x_{CP}, y_{CP})_i$ can be selected on the CPC forming the coordinate vector \mathbf{x}_{CP} ; these points can be easily recognised on M as homologous points $(x_M, y_M)_i$ forming the coordinate vector \mathbf{x}_M . The process continues with *affine* transformation, from which the six unknown parameters of the involved transformation matrix \mathbf{T} are determined. This is the output of elaborating the one-to-one correspondence of \mathbf{x}_{CP} and \mathbf{x}_M according to standard computational methods (e.g. DEAKIN, 2004). The final result obtained is the vector of *residuals* $\delta\mathbf{x}$ describing the degree of *spatial separations* s_i of the *estimated* coordinates of the reference points $(x'_M, y'_M)_i$ forming the vector \mathbf{x}'_M derived from the control points vector \mathbf{x}_{CP} after the best-fitting transformation \mathbf{T} . The symbolic general relations $\mathbf{x}'_M = \mathbf{T} \mathbf{x}_{CP}$, $\delta\mathbf{x} = \mathbf{x}_{CP} - \mathbf{x}'_M$, $\sum \delta\mathbf{x}^2 = \min$ and $s_i = \sqrt{[(x_{CP} - x'_M)_i]^2 + (y_{CP} - y'_M)_i^2}$ summarise the overall process, with $\sum \delta\mathbf{x}^2 = \min$ satisfying the well known *Least Squares Adjustment* condition: ‘the sum of the residuals squared should be minimum. In the case of postulating $\delta\mathbf{x} = \mathbf{0}$ the transformation is of *exact* type biasing the homologous control points on M and CPC to coincide, deforming thus the image of the map elements elsewhere. This is the case of, e.g., the *finite element method* transformation used also in this study (Fig. 1, right and Fig. 6, right), chosen among other relevant transformations.

The process of spatial comparison (comparative analysis) is well known and standard in modern geospatial sciences and engineering, but all the same not familiar to historians who should develop relevant acquaintance in order to follow in more comfort the relevant means of analytical tools available in the era of the Digital, in the same manner the geospatial scientists and engineers should develop acquaintance with the historical issues that concerns cartography. This is the aim of the recent trend in Cartography developed in the field of Cartographic Heritage (LIVIERATOS, 2006) as seen from the ‘digital standpoint’ and the necessary advancement of Digital Humanities in this direction.²¹

The high degree of closeness of CPC to M at certain locations is an indication that those coastal places were for some reason more significant than others, and therefore demanded the acquisition of higher quality of appropriate spatial data, which contributed to a better CPC description and representation.

APPENDIX 4 – *Cradle of portolan charts: the Mediterranean Middle Ages and cultures*

The portolan chart is apparently a distinct product of the interacting cultures of the Mediterranean Sea during the Middle Ages, without ignoring the historical roots and continuity of those cultures. The Middle Ages are conventionally divided into three parts: the Early Middle Ages (EMA) from the 5th to the 8th centuries; the High Middle Ages (HMA) separated in two, the earlier HMA from the 8th to the 11th centuries and the later HMA from the 11th to the 13th centuries; and the Late Middle Ages (LMA) from the 13th to the 15th centuries. The greatest majority of known portolan charts belong to the LMA except for the CP dated to the later HMA, which for this reason alone deserves a study *per se*.

For the most part of the Middle Ages the major cultures potentially active and interactive in the Mediterranean Sea, both militarily and commercially, were the Byzantines, the Arabs, the Latin maritime powers (with evident portolan charting skills in the LMA) and the Sicilian Normans. Of these:

- a) The Byzantines, natural heirs of the ‘Classical’ historical legacy (Greek, Hellenistic and Roman), were the oldest dominating the Mediterranean after Late Antiquity to almost the mid HMA.
- b) The Arabs first challenged the Byzantine naval supremacy targeting mainly the possessions of Constantinople in both the coasts of the lower Adriatic Sea and Sicily.

²¹ The International Cartographic Association (ICA, icaci.org) established since 2005 a distinct venue of Cartographic Heritage, supported by digital technologies, and is active in developing new concepts and contexts relevant to the analysis and revisiting of past cartography and old maps.

- c) The Italian maritime Tyrrhenian cities of Amalfi, Pisa, Genoa and of Venice up in the Adriatic Sea, become the principal Mediterranean naval powers, from the early HMA and after, together with the Catalans and Majorcans from west, also skilled in seas and equally active in the LMA portolan charting.
- d) The Sicilian Normans with particularly interesting, even if short lived, naval presence and activity in central Mediterranean, mainly in the southern Adriatic Sea, challenging strongly the Byzantines already in naval decline, from the 11th to the 12th century.

Looking at the various areas of the Mediterranean Sea, where most naval powers' interests and antagonisms converged at almost the same period, the only one area that satisfies most, than any other, spatial and time concurrences is that of South Italy, the South Adriatic and Ionian Sea with Sicily, and the way around the Peloponnese, Crete and the Aegean Sea, from the early 9th to the late-12th century (early to mid HMA). This means that this area in central Mediterranean and the Aegean was subject of major concerns either for the possession of coastal zones or for gaining trading advantages and profits. Obviously, the natural consequence was the need for knowledge of the coastlines' morphology and eventually for their graphical representations, if necessary, as evidenced in the extensive and long-lasting discussion among scholars on the origin and evolution of the nautical and portolan charts developed by the Mediterranean naval cultures,²² (e.g. MÜLLER, 1855; FIORINI, 1881; FISCHER, 1886; NORDENSKIÖLD, 1897; KRETSCHMER, 1909; GOITEIN, 1960; BALLARD, 1978; FREIESLEBEN, 1983; DILKE, 1987; AVRAMEA, 2002), more often than not criticised as influenced by the authors' own cultural 'sense of national or cultural belonging' (CAMPBELL, 1987; PRESCIUTTINI, 1991; GAUTIER DALCHÉ, 1992).

But why and how arose in the HMA the special naval interest about South Italy and the surrounding coasts? Following the long domination of the Mediterranean by the Eastern Roman Empire thanks to its strong naval force during the entire EMA (e.g. ANTONIADIS-BIBICOU, 1958; AHRWEILER, 1966), the presence of the Byzantines in South Italy, the East Adriatic coasts and Sicily lasted three more centuries, from 867 when the emperor Basil I the Macedon recovered Italy (LAMMA, 1968).²³ The care to implement exclusively naval means in lower Adriatic and in Southeast Italian coasts without deploying forces inland reasonably presumes concern about spatial descriptions of the coastline.

The historical research on the development of the inhabited centres in Apulia showed that the Byzantines always opted for controlling the cities on the sea front than those inland and the Byzantine elite gave early signs of awareness about geospatial descriptions, as did the scholar emperor Constantine VII, in the first half of 10th century, in his *De Thematibus*²⁴ and *De Cerimoniis* where his *Stadiodromikon* provides portolan type numerical data for the Aegean Sea (e.g. HUXLEY, 1976; PRIOR, 2001). The 9th and early 10th centuries are significant in that they marked a turning point in the relationship between Byzantium and the cities of the so-called 'Byzantine Italy',²⁵ due to the political and cultural influence

²² The four 'established' tracks in literature about the cultural origin and evolution of the nautical and portolan charts are (e.g. PRESCIUTTINI, 1991): a) the 'Classical' track, *accumulative* from Antiquity, mainly Greek, Hellenistic and Roman as developed in the Mediterranean; b) the track of the major heirs of the 'Classical' legacy, the Byzantines; c) the *ex origine* track of the Middle Ages maritime cultures of the Mediterranean, e.g. the Arabs, Italians, Catalans, and d) the less followed track related to the events in South Italy and Sicily from the end of 12th century to the late 13th century also with a German reference, after the decline of the Sicilian Normans.

²³ For events in that period useful remains the first half of 10th century *De Administrando Imperio* and *Vita Basilii*, by the scholar emperor Constantine VII, where he explicitly refers to the major problem-solving in mid 9th century that occupied Basil I, namely the Adriatic question, the Ragusa expedition, and the main task given to the fleet to recapture Bari and the part of Apulia named *Longivardia*.

²⁴ In the text are described the Byzantine administrative regions of explicit geographical context in the Adriatic coasts of South Italy and the coasts in the opposite side, among them the important *Dyrráchion*, the Italian *Longivardia* (Apulia – Calabria, the later *Kalavris*) and *Sikelia Nēsos* (Sicily).

²⁵ Typical of the strong Byzantine cultural legacy in Apulia is the case of the *Sant'Erini*, as is called in the region the 4th century saint Aghia Eirini/Santa Irene (in Greek and Italian respectively) martyred in Thessaloniki, venerated by all the Christian Churches that admit the cult of the saints and mentioned in *Menologion* by the Byzantine emperor Basil II in 10th century (Manus. Vat.gr.1613). Patron Saint of the city of Lecce until 1656 and of smaller communities in the prov-

Constantinople exerted there (LAMMA, 1968). At the end of the 12th to the beginning of 13th century it was becoming obvious that the Byzantine navy was no more in a position to intervene in the central Mediterranean and westwards as a sufficiently imposing power (SCUFARI 2002). In any case, the area of South Italy remained under strong Byzantine concern until 1175 when the most ‘western-oriented’ emperor Manuel I Comnenus (MAGDALINO, 2002) failed to retain his possessions there against the Normans who gradually from 1071 to 1198 extended their rule in Apulia, Calabria and Sicily.²⁶

During the turbulent period from the mid-11th to late-12th century, marked by the Byzantine conflicts in South Italy, ANNA COMNENA (1148) recounts in her *Alexiad* the political and military events during the reign of Alexius I Comnenus (1081-1118), her father. In Book *XIII (VII)* she describes the specific and efficient use of a ‘coastal map’ in 1108, sent by Alexius to his fleet along with navigation orders for the difficulty they may encounter at the coasts of Dyrrhachium, a proof of the Byzantine awareness on the use of maps in sea. In the Greek original the word ‘ἡτόνα’ (meaning ‘coast’, ‘shore’, ‘littoral’, formerly also a name of a port near Amphipolis in modern Kavala) is used, which is rendered as ‘map’ in the standard English translation by DAWES (1928). A few years later in Norman Sicily, Al Idrisi,²⁷ the official cartographer of Roger II in Palermo, concluded *Tabula Rogeriana* (1154) almost the same year the Byzantines started negotiations for trading agreements with the Genoese (1155) and becoming trade partners three years before Manuel signed a peace treaty with the Normans (1158).²⁸ Evidently, Byzantium, the Normans and Genoa in the mid 12th century were in close interaction throughout the south-east Adriatic coasts of Italy and the opposite coasts of Dyrrhachium, the area of major CPC closeness to *M*. The Byzantine strong naval capability in the early times and their cultural background as the immediate heirs of ‘Classical’ tradition has led some scholars to entertain as possible an explanation about the origin of the early portolan charts. Without excluding some ‘others’ in close relations with the Byzantines, i.e. the Amalfitans earlier and allies for a short period, or the Pisans, the Venetians (BORSARI, 1988), the Genoese, the ones in closest relations to the Byzantines, realized how extremely crucial was the possession of this knowledge, and developed an interest and the necessary skills to gain in some way access to the accumulated geospatial knowledge, possibly found in Constantinople, which combined any contemporary relevant knowhow of the cartographic endeavour so as to produce something like what the *CP* elaborates. It is worth remembering that Byzantine Constantinople was for long time, and especially in the mid HMA, a ‘maypole’ around which a number of important naval Mediterranean powers and their individual representatives revolved (most of them from the Italian nautical cities) for profits and privileges of any kind, including territorial settlements.

The Byzantine track evolved in earlier specialized literature, even if the (strict) material evidence to support it unequivocally, including mapmaking, was sometimes missing in certain fields, which must have been accumulated since Late Antiquity. On present evidence, however, the missing link may be due either to the devastating circumstances and the consequences of the looting in 1204 and the violent

inces of Bari, Brindisi and Taranto in the ‘Land of Otranto’ (Salentine peninsula), Aghia Eirini/Santa Irene was celebrated since 5th century in the homonymous Byzantine church on the Island of Thera, Cyclades in the Aegean Sea, excavated in today’s village of Perissa during the late 20th century. The island is widely known with the name ‘Santorini’, a verbal alteration of the use of the Saint’s name in various mainly Italian dialectic forms: e.g. in Al Idrisi’s *Tabula Rogeriana* the island’s name is ‘santari’ and in *CP* ‘Sant(e)rin’.

²⁶ The Sicily Normans further challenged Byzantium by invading its European territories twice, in 1147–1149 and later in 1185–1186. It is interesting to notice that among the strongest rulers in 12th century, namely Frederick Barbarossa, Henri II of England, Saladin, Roger II of Sicily and Manuel I Comnenus (MAGDALINO, 2002), only the last two engaged in direct conflict in the adjacent coasts of south Adriatic Sea.

²⁷ Al Idrisi had good acquaintance with the Greek and Arab geography and cartography, gained during his traveling from the early 12th century until he was called in Palermo in 1145 by the Norman king, Roger II of Sicily as the official cartographer (NANETTI, 2011; with selected relevant literature).

²⁸ Between 1168 and 1175 Eustathius of Thessalonica wrote a widely diffused geographical commentary on Dionysius Periegetes influencing Byzantine politicians active in diplomatic negotiations for the Empire’s interests in southern Italy.

fall of Constantinople in 1453; or, as has been implausibly argued, because the Byzantines remained ‘eventually indifferent’ to practical matters and their elaboration about issues intimately related to *CP*.

The impact of the Genoese in their ‘first phase’ relations with Constantinople was significant. After the First Crusade (1094-1097), the commercial naval power of Genoa in the Mediterranean was visibly enforced, and the Genoese became a first rank political, economical and military naval power.

In 1155 Manuel I approached Genoa in his quest for an alliance against the Normans, the year of a great military naval activity of the Byzantines in the area from Bari to Taranto, in order to recover the eastern regions of southern Italy mainly along the coastlines of Apulia and Calabria. Meanwhile, Manuel was trying to muster remarkable reinforcements to send to Italy (LAMMA, 1955, according to Byzantine historian Ioannes Cinnamus) but the entire enterprise for recovery failed and thus ended the Byzantine aspirations and their presence in South Italy in 1158. The Genoese signed subsequently important agreements with the Normans in 1156 and 1157 (LISCIANDRELLI, 1960) concerning their interests in the seas of South Italy. Clearly, through trade expansion Genoa and Sicily were closely related and the signing of agreements followed (ABULAFIA, 1977). Apparently, this development urged Manuel to try to attract again the Genoese commercial interests and partnership in the 1160s, which in any case was uneasy and unstable (LAMMA, 1955; CLASSEN, 1968; BEKKER, 1835, ref. to Byzantine historian Nicetas Choniates).

Constantinople re-established relations with Genoa in 1192, when amicable and profitable relations were restored under the emperor Alexius III, who did also the same with the Pisans, both Tyrrhenian powers in rivalry with Venice (BRAND, 1968), but the Genoese succeeded in acquiring important territorial gains in Constantinople in 1201. The intense and turbulent relations of the main Italian naval powers with Byzantium in the entire 12th century was also fuelled by the urban settlement negotiations in Constantinople, of crucial importance for the Pisans and Venetians, whilst the Genoese were mainly concerned with trade and mercantile affairs and related maritime privileges (ORIGONE, 2001).

Equally important was the ‘second phase’ of the Byzantine-Genoese relations. The ‘Treaty of Nymphaeum’ signed in 1261 between Genoa and Constantinople renewed again Genoese privileges under a new Byzantine rule. Before this date, the relations of the Genoese with the violently established Latin rule in Constantinople (1204) were rather weak (OTTEN-FROUX, 2011), and Genoa recovered contacts with the Byzantines only in 1261, after the new Palaeologan dynasty from Nicaea overturned the Latin rule in Constantinople and established the last and longest-lived dynasty of Byzantine emperors.

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