

Nopi Ploutoglou *, Maria Pazarli **, Kostas Papadopoulos ***

The digital rotational and scale fitting of Bordone's isolario in a continuous insular map of Greece

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Summary

Isolarii, a sort of geographic atlases of islands focused mainly on the Aegean Archipelago, a typical Italian renaissance invention, consist an important chapter of the history of cartography even if, from the pure cartographic point of view, they are collocated aside the advancements of cartography at that period. From early 15th century, starting from Buondelmonti, and for almost three centuries, the islands of the Aegean attracted the interest of many important authors, who wrote these atlases which became popular readings in Europe, raising the interest for this Sea which was vital for the security and the market interests of the Italian naval powers of the time. Among these *isolarii*, that of Bordone, in the first half of 16th century, is considered a point of reference. In this paper, the islands of the Aegean and Ionian seas as depicted in Bordone's isolario, are positioned on a modern map of the region, applying a fit in scale and orientation with respect to their actual locations, designing thus, a Bordone's continuous insular map fitted to actual scale and orientation. The spatial distribution of scale and orientation variations in Bordone's depiction of the Aegean and Ionian islands are then constructed.

Introduction

Isolarii, the geographical atlases of the islands, focused mainly on the Aegean *Archipelago*, are typical products of the Italian renaissance, reflecting the strategic and financial priorities of the flourishing Italian centres at the Aegean Sea. Starting from 1420, when Cristoforo Buondelmonti wrote the first, these *isolarii* written in total by almost thirty authors, in three centuries period, almost half of them only in 16th century (see Tolia 2002, for an exhaustive study on the issue), are important chapters in cartographic history, worth to study and analyse not only as historic geographic documents but also from a pure cartographic point of view.

There is also another reason which motivates our interest for the study of *isolarii*. Thanks to these texts, after a long time of bitter contrasts between the Christian East and West, the renaissance world 'rediscovered' the Aegean *Archipelago*, re-evaluating its cultural and ethical importance. It is characteristic that some modern scholars suggested that the Buondelmonti's *isolario*, the first archaeological cartographic work ever and Ciriaco

* Degree in Surveying Engineering AUTH, MSc in Cartography and Geography AUTH, PhD Cand., Aristotle University of Thessaloniki [plouto@topo.auth.gr]

** Degree in Archaeology AUTH, MSc in History AUTH, PhD Cand., Aristotle University of Thessaloniki [pazarli@topo.auth.gr]

*** Degree in Surveying Engineering AUTH, PhD in Cartography AUTH, Assistant Professor at the University of Macedonia [kpapado@uom.gr]

Pizziccoli's first in situ archaeological reporting on classical Greece, in early 15th century, were in fact the starting points of a new positive process toward 'philhellenism' (Ettiene and Ettiene 1990). A procedure which was enforced by the influence of the Byzantine scholars, who arrive in Italy since the beginnings of 15th century carrying the still unknown there knowledge of Greek classical antiquity, and culminated after the Fall of Constantinople, taking a consistent form in West Europe in early 19th century.

In the isolarii, the *Archipelago* dominates the geographic reading, introducing the 'new' world of Greek antiquity focusing a major intellectual interest on that region, in an era when the Great Discoveries beyond west seas, opened new geographical perspectives. Among the isolarii, Benedetto Bordone's of 1528 (Fig. 1), is of main interest because apparently is the one which influenced more the overall offshoot-course of this specialty (Tolias 2002: 179).

Benedetto Bordone (or Bordon, in Venetian mother tongue), was born in 1450 and died in 1530 in Padua, but lived and worked mainly in Venice. A lively, restless and liberal man of his era, well known mostly for his works in decorative art, is distinguished at last as editor, by concluding his *Libro*, called later *Isolario*, his supreme and last work, printed in Venice just before his death. Self-instructed in geographical knowledge gained soon the ambition to offer a tutorial, cultural and divertive text and to contribute in the enrichment of scientific geographical knowledge about the islands, characterizing his own work as "topographical".

Bordone seems to recall a lot of historical sources of various origins, sometimes reliable sometimes not, combined with geographic and cartographic data e.g. the islands' geographic parallels, the distance between them, the orientation according to the *rose of the winds*, the coastline length, the insular human geography and the insular biota. The result is a fascinating narration which attracted the readers, becoming his *isolario* a popular geographic and travelling reading as it is shown by its numerous re-editions for almost half century (1534, 1547, 1560-1570).



Figure 1. Left: *Libro* di Benedetto Bordone, 1528. Right: *Isolario* di Benedetto Bordone, 1534.

Written in the Venetian dialect, Bordone's isolario "*Nel qual si ragiona di tutte l'isole del mondo con li lor nomi antichi & moderni, historie, favole & modi del loro vivere & in qual parte del mare stano & in qual parallelo & clima giaciono*"¹ is giving to his readers, thanks also to the very title of his book, the impression that the great majority of the islands of the world are in fact at the Aegean Archipelago and the Ionian Sea, since among the 82 frames of islands described in his isolario the 29 are at the Atlantic, 10 at the East Seas and 43 at the Mediterranean, mostly in the Aegean and the Ionian! In the Aegean and the Ionian seas the number of bigger and smaller islands, depicted in single frames, is about 50 (Livieratos et al. 2000).

Each island is imaged in a bordered frame in which some minor islands and islets, escorting a main one, are also depicted together with continental coast-lines when the islands are near the coasts. There are cases where the same islands (mainly the smaller ones), or parts of them, are included in more than one frames. In these cases one could observe differences in distances and/or orientations (even in relative sizes and shapes), which demonstrate the low interest for precise cartography, at least in isolarii of this period.

Comparing to other insular regions, the Aegean and the Ionian insular representations are mostly complete, with very few exceptions (only two Cycladic islands, though important, are missing in the Aegean, namely Serifos and Syros). On the contrary, in other cases we notice severe deficiencies, as e.g. in the east Adriatic insular area of Zadar – Sibenik, where the entire insular complex is totally missing as well as important islands in the Dalmatian insular complex (Livieratos 2004: 370).

In this paper, the Bordone's islands of the Aegean and Ionian seas, are properly placed on a modern map of Greece, applying a fit in scale and orientation with respect to their actual locations, constructing thus, a revised 'modern' version of Bordone's continuous insular map which is given in his isolario. The spatial distribution of scale and orientation variations, derived from the fit of Bordone's depiction of the Aegean and the Ionian Islands in a modern background, are then constructed.

The 'continuous' map of Bordone's insular Greece

The interest on isolaria and especially on that of Bordone's, started at the National Centre for Maps and Cartographic Heritage in 2000, in cooperation with the Centro Interdipartimentale Rilievo Cartografia Elaborazione (CIRCE) of the University IUAV of Venice². The result was a map (Livieratos et al. 2000) on which 50 islands³ of the Aegean and the Ionian seas as given by Bordone (Fig. 2), were spatially placed on a modern map, with respect to their actual positions.

In this sense, it is reconstructed in modern terms and of course in greater scale the generalized small scale map of the entire Aegean Archipelago given by Bordone himself in his isolario (Fig. 3), excluding the islands of the Ionian Sea. In this collective map,

¹ "*In which all islands of the world are handled with their ancient and modern names, histories, legends and ways of living and in what part of sea are located and in what parallel and climate are sited*"

² According to a research project agreed between the two institutions.

³ Smaller islands (and islets) depicted close to the principal ones are included in this number.

Bordone's liberty in designing the orientation and the scale of the islands is more than evident.

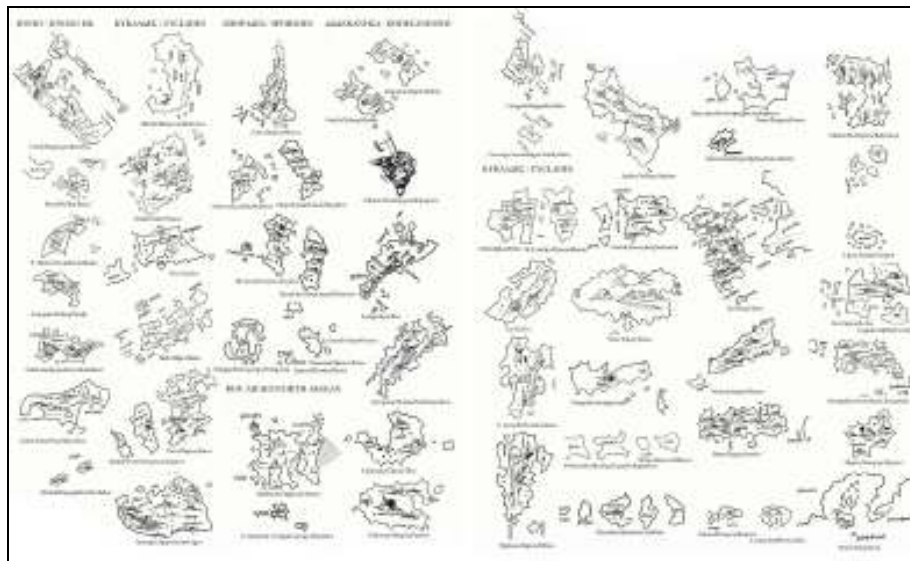


Figure 2. The islands of the Aegean and the Ionian seas depicted in Bordone's isolario



Figure 3. Bordone's synthesis on map of the islands depicted independently in his isolario.

After having identified Bordone's toponyms with the actual toponyms, each island or complex of islands was placed in its right geographic position on a modern map. Differences in scale and upwards orientation to the north are evident in the isolario thus, a fit was necessary in order to get the proper geographical image, creating the new insular continuum as a single map.

In Bordone's isolario, as it is normal in this typology of geographic depictions, each island, or a complex of neighbouring bigger and smaller islands, are given in independent

frames, which are associated with and referenced in the text. There is no uniformity in scale keeping thus, no visual comparison of sizes can be made, though relevant information on the islands coastline length and on distances between the islands are given in the text. In Fig. 4, the longitudinal width of the two islets of *Strivali* is slightly greater than that of *Pacsu*, as given in Bordone. In reality the relevant width of *Strivali* is about 1,5 times shorter than that of *Pacsu*.



Figure 4. Ionian Sea. Left: The island of *Pacsu* (Paxos). Right: The islets *Strivali* (Strofades)

Shapes are also rather descriptive, while the orientation is well documented with the principal directions of north and east. For obvious reasons related to the paging economy, this orientation is not uniform throughout the isolario text. The north direction is varying from frame to frame thus a rotation change should be applied to bring all island images in the same orientation with the north upwards. This is mainly the case in the Aegean, while in the Ionian, with the exception of Corfu, the orientation is kept 'normal' with north upwards (Fig. 5).



Figure 5. Ionian Sea. Left: The island of *Zafalonia* (Cephalonia). Right: The island of Corfu.

In Fig. 6, the spatial distribution of the islands in Bordone's isolario is shown in red dots. The areal coverage in pink represents the major islands *Candia* (Crete) and *Negroponte* (Euboea), the Peloponnesus and the Holy Mt Athos peninsula. The two important islands missing are Serifos and Syros, in Cyclades, shown in blue dots.

The spatial distribution of changes in scale and orientation

The construction of a continuous insular map derived from Bordone's isolario requires the following four principal processing steps:

- a. The identification of the islands according to their name in Bordone's text
- b. The rotation of the island image to bring North in upwards position
- c. The placement of the islands in the proper geographic position
- d. The similarity 'resizing' of the islands to fit their actual size.

The process followed in this study, is summarized in Fig. 7. It is evident that the scale fitting is more complex compared to the rotational fit which is nevertheless necessary for the scale fitting.

The toponyms of the Aegean and Ionian islands in Bordone's isolario are according to the Venetian naming which in some cases look some how similar to the ancient and modern Greek names (*Pacsu, Zafalonia, Amurgo, Scarpanto, Tino, Samo* etc.) and in some other are quite different (*Compare = Ithaca, Dromo = Alonisos, Lango = Kos, Cerigo = Kythira, S. Luca = Kythnos* etc.).

The orientation of the islands, as they are depicted in the image frame, is not always with the 'normal' direction of the north upwards. Only the half of them is oriented with the north upwards. In Fig. 8, the frequency of the 'orientations' of the north in the islands' representations shows the rotation each insular representation should undergo in order to bring the north in the upright position.

In Fig. 9, it is shown the area of the Aegean Sea with the spatial distribution of the rotation, which should undergo each insular representation in Bordone's isolario in order to bring the north in the upright position. Of course, the illustration of the spatial distribution which is plotted after a regular point interpolation process falls into the typical way the spatial distribution of a variable is represented by isarithmic contours, according to the classical topographic drawing practice. It gives an image of how the trend of the variable (here the rotation) is behaving in space. It looks that this rotation is changing in the Aegean *Archipelago* according to a strongly non-uniform pattern. The main result is that, the representation of the north direction of the smaller islands in the Aegean complex is more or less close to the upright north as given in Bordone's isolario.

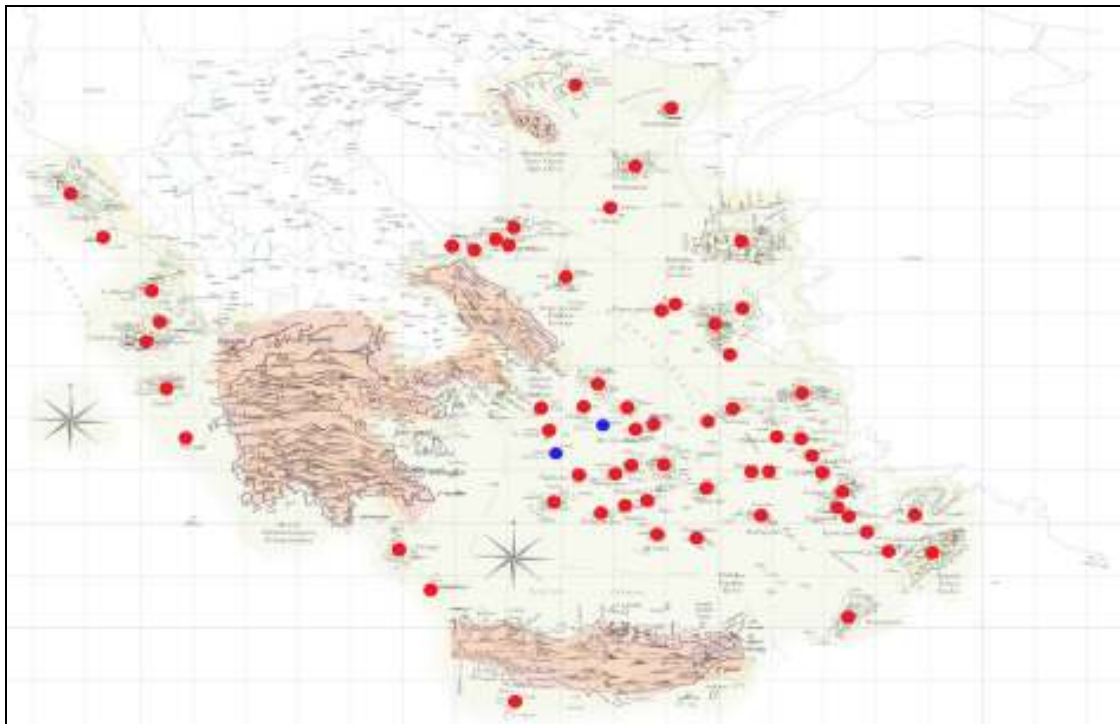


Figure 6. In red dots: The spatial distribution of the islands in Bordone's isolario. In areal pink: The major islands *Candia* (Crete) and *Negroponte* (Euboea), Peloponnesus and Holy Mt Athos peninsula illustrated in Bordone's isolario. In blue dots: Two important islands missing Serifos and Syros, in Cyclades.

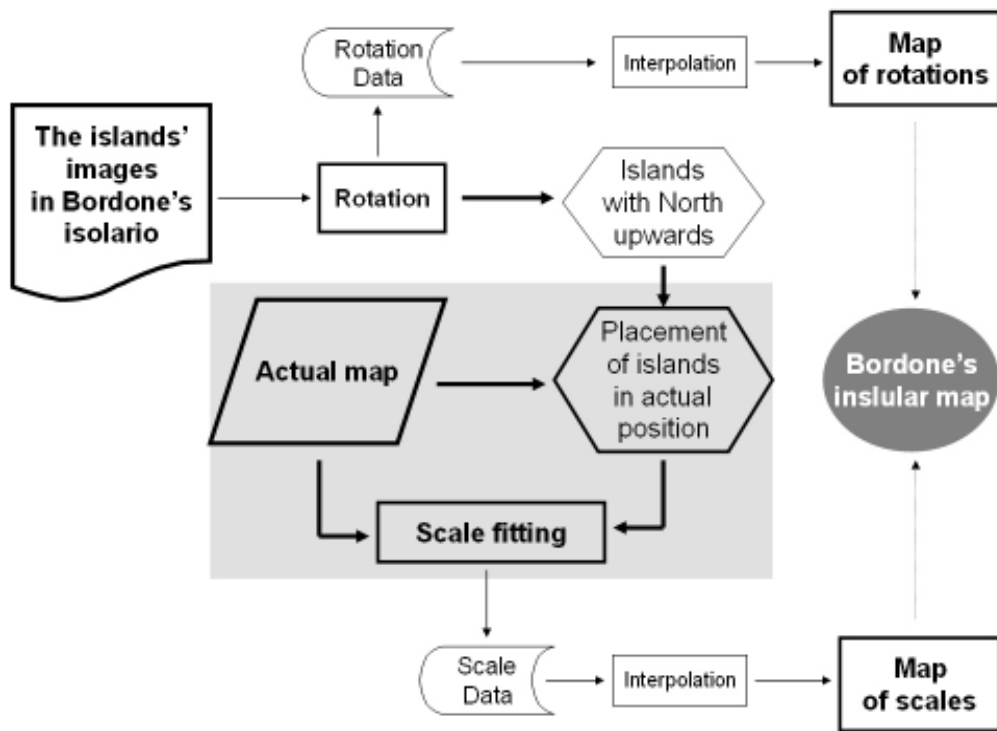


Figure 7. The work-flow followed in this study.

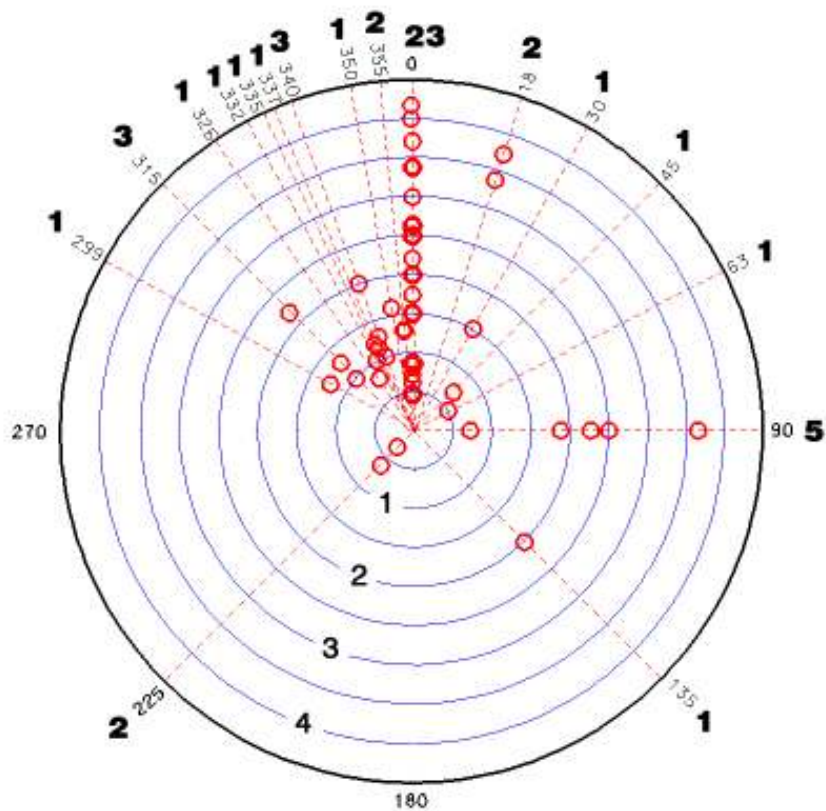


Figure 8. The angular frequency of the orientations of the North in the Bordone islands' representations (the number of islands at the end of direction) shows the rotation each insular image should undergo in order to bring the north in the upright position. The scale magnification is given in blue circular contours.

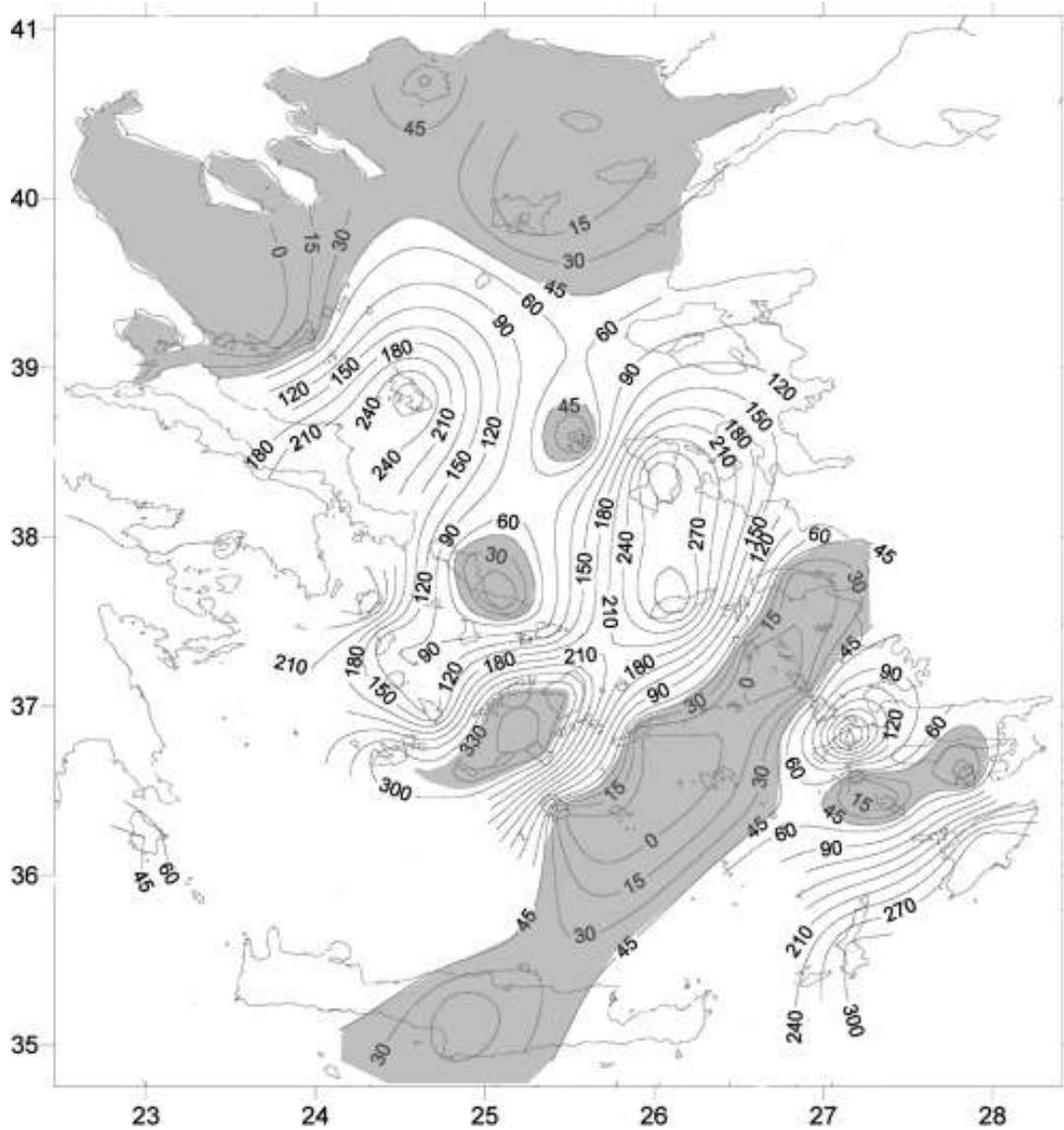


Figure 9. Aegean Sea: The spatial distribution of the rotation each insular representation in Bordone’s isolario should undergo in order to bring the north in the upright position. The shaded areas represent the $\pm 45^\circ$ rotations fan which should be applied in order to bring the north in the upright ‘normal’ position.

On the contrary, all islands of Ionian Sea in Bordone’s isolario are oriented with the north upwards. The only exception is the representation of Corfu in which the north should be rotated 225° clockwise in order to reach the upright position (Fig. 10).

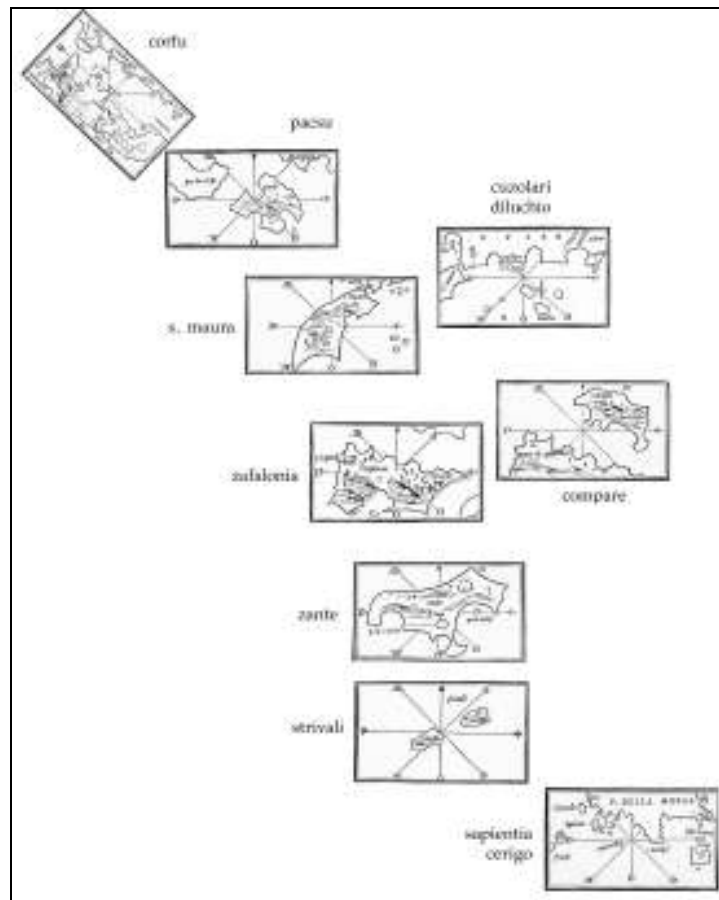


Figure 10. Ionian Sea: With the only exception of Corfu all other inslands in Bordene’s isolario, are oriented with north upwards.

The study of the spatial distribution of scale is more complicated than the rotational case. After having rotated all Borbone’s islands, they were placed on their proper geographic positions with the use of a modern map as the background basis. This was done by exact overlapping of the barycentre of each island image in the Bordone’s and in its actual representation. Then, using a cross hair in both images centred at the barycentre (Fig. 11), a simple best conformal fit (Boutoura and Livieratos 2006: 60) is carried out fitting the image of Bordone’s island onto the actual relevant island’s image.

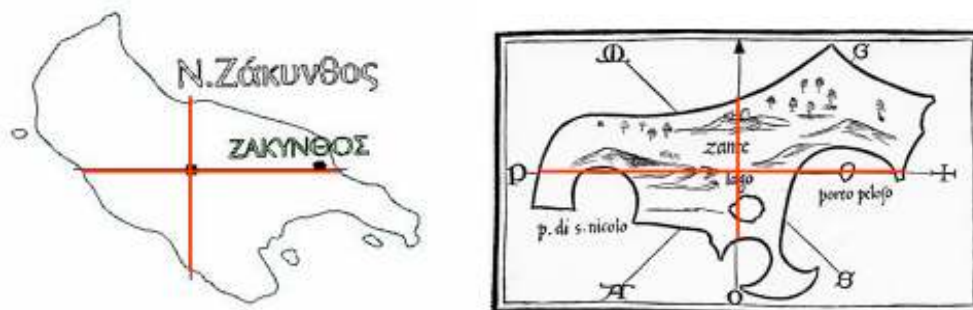


Figure 11. The basis for the scale fitting.

The process is repeated for all islands, keeping unaltered the scale of the images of the actual islands as represented on the modern map used. After the conformal fitting, using a

four-point cross control scheme, the scale comparison is made graphically and relevant maps of scale difference distribution are plotted for the Aegean and the Ionian seas with very interesting results. In Fig. 12, the spatial distribution of the scale at the Aegean Sea is shown, where the shaded areas indicate stronger scale alteration, namely magnification, in Bordone's isolario.

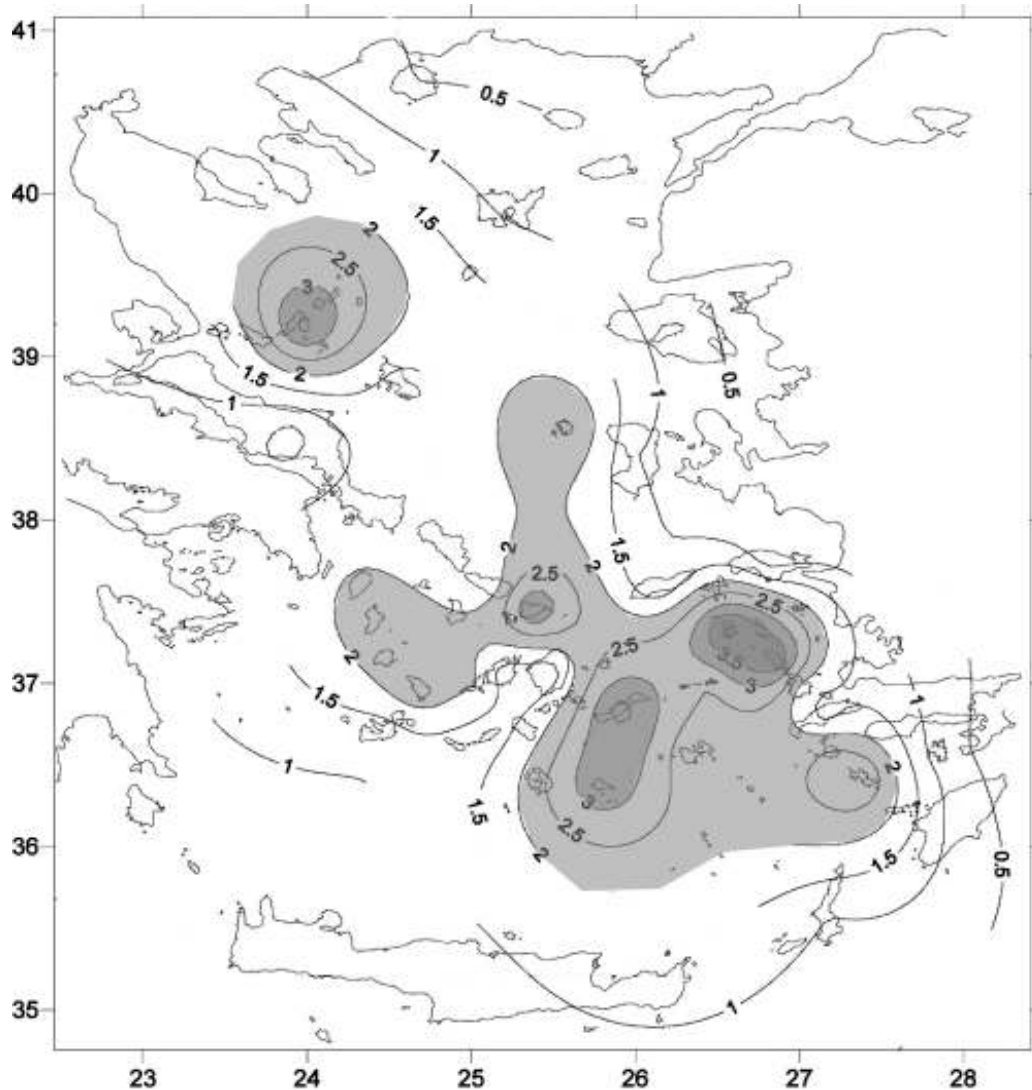


Figure 12. Aegean Sea: The spatial distribution of the scale.
The shaded areas show stronger scale alteration (magnification) in Bordone's isolario

The results show that the depiction of the great islands of the Aegean *Archipelago* in Bordone's isolario e.g. *Stalimene* = Limnos, *Metelin* = Lesbos, *Sio* = Chios, *Samo* = Samos, *Negroponte* = Euboea, *Candia* = Crete, *Rhodo* = Rhodos, retains unit scale representation compared to an actual map. On the contrary, smaller islands are imaged by Bordone 1,5 to 3,5, or more, times larger for insertion in the text's image frames. This is also the case for the depiction of the islands of the Ionian Sea, as it is shown in Fig. 13, always remembering the essential remark on the technical characteristics (advantages and limitations) of the representation with isarithmic lines drawn with the interpolation of point values.

Concluding remarks

In this study we show that the important ‘literature’ of the *isolarii* in the geographic and cartographic history offers not only valuable textual information on the insular component of the world but also pure cartographic, regarding the orientation and scale approach used by the *isolarii* authors in order to represent the islands, which was the very fundamental pictorial part of the atlas.

The approach we followed here was just to illustrate the procedure of fitting the individual images of the islands, framed as units in the *isolarii* text, in an actual insular continuum (in our case the Aegean and the Ionian seas) as represented on a modern map.

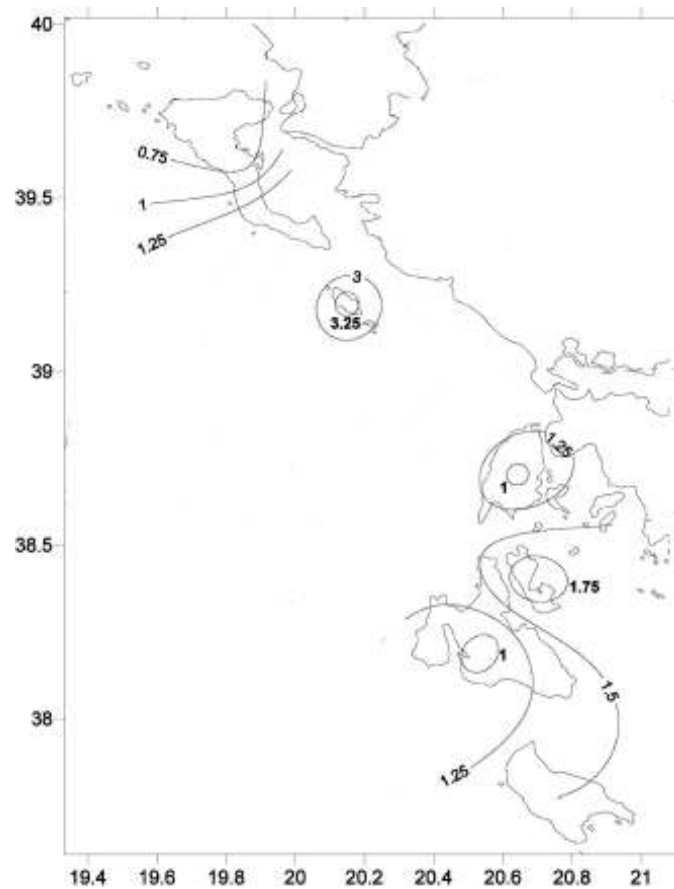


Figure 13. Ionian Sea: The spatial distribution of the scale.

The individual islands are rotated to fit the upright direction of the North and then following a more complex process, the rotated island-images undergo a conformal fitting to approach the size of their counterparts represented on the modern map. In this way we can study, in a spatially unique insular continuum:

- a. The representation technique followed in the *isolarii*, concerning the rotation of the North,
- b. The magnification of island-size adopted by the *isolario* author, and furthermore
- c. How to get a qualitative, in this stage, overview, in spatial sense, of the distortions of the *isolarii* islands with respect to their actual counterparts.

From point (a) we observed that there is no systematic pattern according to which a conclusion can be reached on a specific rotational approach followed by the isolario author. This is not the case for point (b) because the analysis showed that for the scale, a method of representation clearly exists, for a gradual magnification of the islands according to their size. In this way, even tiny islands and islets which are missing in a regular modern map (for generalization reasons due to scale) are on the contrary represented in the isolario, making it thus, more important in studying insular complexes. Commenting on point (c) we have to note that, in general, the shapes of the islands in the isolarii (actually we are talking about the shape of the coastline) are not respected with ‘devoutness’ by the author. It is amazing to see how the same person vesting as an isolario author and as a mapmaker represents the same island in two different ways (it is, e.g., the case of Antonio Millo, as shown by Livieratos and Boutoura 2000).

The study of fitting the shapes and for the verification of geometric quantities given in the isolario text (e.g. distances between the islands, coastline lengths etc.) is a further research which has to be made, together with the extension of this study to other isolarii, in order to study and identify, on a common comparative basis, similarities or differences and methods of approaching the representation of the single islands in the isolario text or, in other words, to approach the cartography of the isolarii.

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