Managing Different Scales in Intra Site and Micro Regional Analyses using GIS

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Abstract

The main objective of the paper is to present micro regional and intra site analyses of the mainly Bronze Age site of Pianaccia di Suvero, La Spezia (Eastern Liguria, Italy). During ten years of field work on the site and its vicinity, large and complex data have proved evidence of a settlement, ranging from the Early Neolithic to Bronze Age. Most significant is the discovery of a workshop for the production of steatite ornaments. An intense occupation, probably related to a Middle Bronze Age anthropic activity and recent agricultural practices, have caused erosion of lower layers and a deep accumulation of modern colluvium.
During the field work a variety of different techniques was used, ranging from non destructive techniques like artefact surface collection and geophysical surveys to pedological investigations and excavations. All relevant documentation on site and its micro region was integrated into a geographic information system. The main objective of the analyses performed was to correlate intra site data and micro regional data enabling insight into the prehistoric frequentation of the site and elaboration of the archaeological sequence. During the work innovative solutions on handling inconsistent spatial information, especially coming from varying scales were used.

Introduction

One of the reasons of the outstanding success of GIS technology in archaeology, is the possibility, as it is offered by such systems, to put together maps with different scales in a same context.

But while planning a GIS based on a multi-scale cartography, we cannot ignore the different precisions of the embedded geographical data. This inconsistence can be solved using multi-precision as it happens in the modern numeric cartography.

Pianaccia di Suvero: A Case Study

Some of the methodological approaches the Authors would like to suggest in this paper have been applied to the elaboration of a GIS of the prehistoric site of Pianaccia di Suvero (near La Spezia, Eastern Liguria) (Rossi 2002).

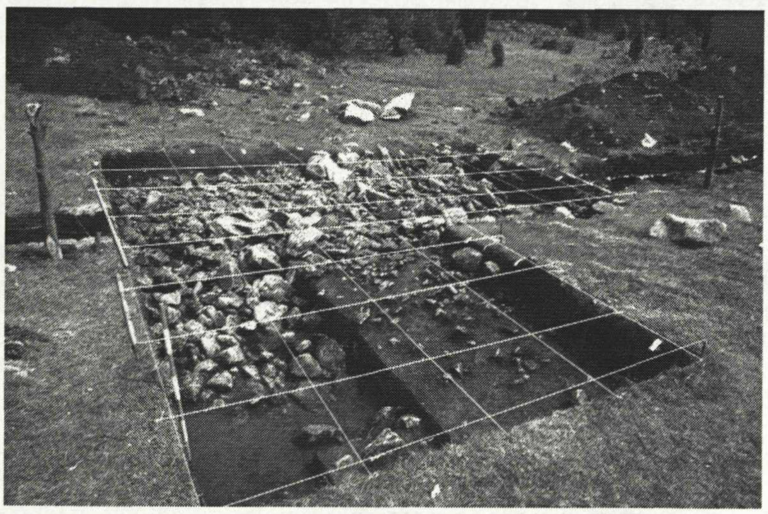

Figure 1 The site during the 1984 campaign

The site area has been studied for over 30 years since the beginning of 70s (Maggi 1984, 1987, 1990, Giardi and Maggi 1980). In particular, during ten years of field work on the site and its surroundings, carried out by Soprintendenza Archeologica della Liguria in the 80s, large and complex data have proved evidence of a settlement, ranging from the Early Neolithic to Iron Age.

The site area comprises a generally north south trending gently sloping interfluves sharply bounded on the north and west sides by precipitous slopes.

In the southern part of the site, characterized by Neolithic findings, artefacts occur in the deeply weathered soil apparently, most of sites and upper archaeological levels may have been lost by erosion. Otherwise, in the north-eastern area, because of terracing on the southeast and southwest sides, the archaeological sequence has been preserved from the modern erosional phase. The main Copper Age occupation involved the construction of a stone platform or some other structure. Intense occupation took place. Most significant is the discovery of a workshop for the production of steatite ornaments in the Middle Bronze Age Layers (Gernone 1994, Gernone and Maggi 1998).

During field works a variety of different techniques was used, ranging from non-destructive techniques like artefact surface collection and geophysical surveys to pedological investigations and excavations.

Almost 30 years of research produced a great amount of data and a complex multi-scale cartography

MULTI-PRECISION

The data available for an information system of the archaeological area of the Pianaccia di Suvero were embedded in a wide range of map of different precision:

- 1:25,000 cartography (IGMI, Italian Military Geographic Institute);
- 1:25,000 geological map;
- 1:10,000/1:5,000 cartography (CTR, Italian Regional Technical Cartography);
- 1:10,000 orthophoto, reporting erosion and vegetation cove rage;
- Geophysical survey data drawn on CTR 1:10,000;
- 80s Survey map free-hand drawn on CTR 1:10,000;
- 1:2,000 cartography, reporting the positioning of archaeological excavations;
- Free-hand - no scale - drawings reporting the positioning of 70s surveys;
- Archaeological planimetric cartography 1:10.

Of course these data are not directly comparable (Voorips 1998:256). On handling the informative contents of this cartography we must carefully consider the representation of the geographical data in different scale. In fact the presence of different scale involves a different precision of the relative spatial data.

For instance, it is obvious that, if we consider the draw of a street on a little scale map (i.e. 1:25,000) transposed into a smaller scale (i.e. 1:1,000) the street's dimensions will not correspond to the dimensions it would have had if drawn in this scale.

The same thing happens considering the perimeter of a building. If we draw it on a 1:25,000 scale map it will be 2 millimetres thick (Fig.2a) while the same outline, in a 1:100 scale map would correspond to 5 meters on the ground (Fig.2b). At this scale, we could draw a more precise profile of the building inside that line even rotating it according to real data (Fig.2c).[1]

On the other hand we cannot give up to use more precise data from a great scale map (as, for instance, the 1:10 archaeological documentation) into a wider context (i.e. 1:2,000 cartography) only for the difficulty connected to their dissimilar representation.

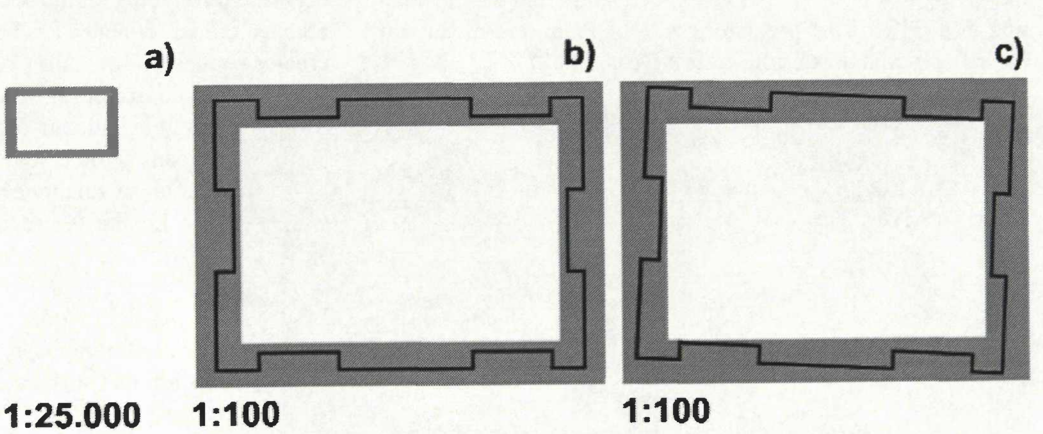

Figure 2a The perimeter of a building drawn (in grey) on a 1:25.000 scale b-c) the same object in a greater scale (1:100) with a more precise drawing of the building (in black).

The inconsistence of different spatial data can be solved using multi-precision as it happens in the modern numeric cartography where a little scale is used for acquiring urban areas (1:1,000) and a medium scale (1:5,000) for all the other area. This method requires to resolve the consistence of the great scale details into minor scale representation (Jones et al. 1996, Egenhofer, Clementine and Di Felice 1994).

In this case, all the spatial data were acquired into the GIS, without affecting their precision, and georeferred using minor scale cartography. For Instance, the 1:10 archaeological plan were georeferred using the 1:2,000 map and in a similar way, this map, reporting the positioning of stratigraphical excavations, was integrate into the 1:5,000 CTR Cartography in a Raster Tiff format that was already georeferred according to the Italian Geographical System, Roma 40 and Gauss-Boaga coordinates.[2]

All the subsequent operation, regarding the different maps described above, were operated applying rototranslation, projective dilating and other similar transformations trying to superimpose points well recognizable on the both maps considered.

For the archaeological plan were used conformal transformations which preserve the consistency of the internal proportions of the image.[3]

This process, trying to compensate the differences instead of completely cancelling, consents to maintain the geometrical consistency inside the major scale cartography.

Once completed the vectorialization of the raster images, inside the GIS, the attributes of the relational database were fully connect to the relative spatial data represented with the different precisions of the vectorial cartography.

As cleared above, we chose to discard simply formal collimations to guarantee the internal consistency of the major scale data without using rotations and other transformations that we cannot surely verify.

The organization of data with a multi-precision method was possible since a Geographical Information System does not share the limitations of the traditional drawing on paper and may consequently represent objects of different detail with a progressive precision.

Conclusion

All the step described above have determined the organization of all the data in a unique Information System that allowed to carry out archaeological analyses on both an intra-site and a micro-regional scale (see, for example, Fig.3).

The main objective of the analyses performed was to correlate intra site data and micro regional data enabling insight into the prehistoric frequentation of the site and elaboration of the archaeological sequence.

Pointing out the existence of a specific "cartographical threshold" does not mean to forget the relative precision required by the context and your own goals. Of course, you have always to apply a logical discrimination (a "logical" threshold") which depends on the different uses of your spatial data.

1 This would result more striking if we consider a 1:10 archaeological plan.
2 In this case, rather than a bilinear warping method, that apparently will have guarantee a better precision, it has been preferred a method that allowed to maintain the measures of the major scale cartography in a minor scale.
3 In fact, it has been applied geometrical corrections based on the relative distance between known points of the image using projective transformations rather than deformations like rubber sheeting.

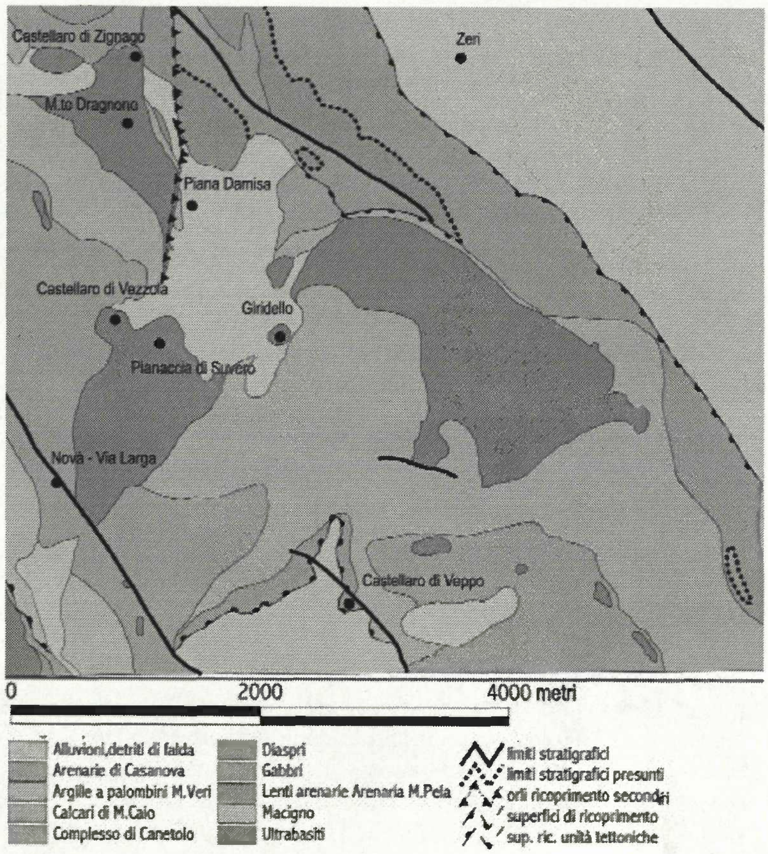

Figure 3 The positioning of prehistoric site around Pianaccia di Suvero on the geological map. It's possible to find a strategic choice connected to the geological parent material

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