The representation cartographic and GIS. Sperimental investigation on medium and low Valle del Tronto

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Abstract

Thise thesis relates to research in the area of representation and design, which in this context means describing and disseminating information related to the environmental heritage, the landscape, and the urban environment.
The objective is to represent an area of land, that of the Tronto Valley, by means of a system for collecting, processing, and organising data to be contextualised at a later date with the help of a geographic information system (GIS).
The innovative aspect of the thesis lies in the representation of data with a graphical language that can communicate information gathered at different scales. Furthermore, an attempt was made to create a two- or three-dimensional model that allows the valley to be read globally.
The thesis started with research related to what has now developed into the representation of land according to morphological, hydrographic, human, and ecological aspects. In this way it was possible to define various analysis categories and at the same time assess the potential or weaknesses of the methods used.
To understand the relationships between the various data, objective, "real" data-reduction systems were compared by means of abstraction and selection in order to facilitate the systems' overall communication capacities through thematic reduction.
The complexity of the case study necessitated in-depth analysis and descriptions Graphical indicators were used that were appropriate for translating the data in its entirety together with the underlying relationships among the various types present within the subsequent system.
This complexity formed the basis for construction of the model and therefore of its information content. In this way, territorial representation becomes the object of a formal graphical communication projectcommunicating a territory is the basis of its representation!
The final model is therefore the re-composition of geographical data by means of a new computer system capable of doing so, creating a communication system that is effective in producing a graphical description of territorial complexity.

The thesis is about the representation and design, considered as a tool for the description and diffusion of information relating to the patrimony, landscaping and urban environment.
The target is the simultaneous representation of a lot of information in the territory, of Valle del Tronto, through a system of collection , elaboration and organization of data inserted and analysed at a later stage, represented through a geographical information system.
For the definition of this methodology it was necessary to outline a cognitive framework through which we can reach an identification of themes structuring the project and the organization of research.
At a later stage the categories of analysis were defined to carry out the investigation, and the methods and forms to realize the knowledge, in two complementary phases, the one concerning acquisition of data and the other about the construction of the information through its representation.
"Different are the areas that can be of interest by GIS application: from the computerization of PRG (general regulation plans) to the network organization, from the verifying system of territory fiscal frameworks to the urban traffic plans, from GIS for the civil protection (seismical maps, building vulnerability, road practicability, ...), from the naturalistic resources to the cultural heritage for tourism, from the sustainable development to the bio-diversity.
Geography, environment, the Internet and GIS, basically seem tightly tied and we could expect to find a large number of applications on the web that make information georeferenced available through interfaces of GIS types with data layer interactively questionable by the users. In reality this does not happen"[1].
The thesis therefore deals with the innovative aspect of the data representation through a graphic language, able to communicate the information gathered at different levels of representation.
The visualization through the GIS is often limited to one single representation: two-dimensional or three-dimensional, then the thesis tries to realize a two-dimensional/three-dimensional model that allows a correct reading of the territorial system.

1. Sofia Pescarin, *Le applicazioni WebGIS per l'ambiente*, Mondo- GIS, 2002, n°32, pp.54-55.

The software Autocad Map3D was chosen as a tool for exporting the documentation on the web.
Thus one can two-dimensionally and three-dimensionally describe the territory and export the documentation in a format which is consultable via web.
Because of this, the release of information is an indispensable aspect today, so that planning and ground analysis are constantly up to date, the research aims at the realization of a data system accessible via web.
The research has a finite territory as a sample, whose characteristics are recognizable and comparable with other areas. The geographical territory of the representation is Valle del Tronto.
The choice of the sample was validated throught the sperimental phase.
The valley is a very diffused model of landscape in Italy as it is in the rest of the world. It is also subject to various studies because its nature is particularly prone to being anthropic, confirming what stated by Prof. Motta "Alberti in *De re Aedificatoria* quotes exclusively literary taken from antique sources" that illustrates the relationship themes between the city and river which crosses it, such as for example the system of water supply to fulfil various urban functions, the defence system that in some crossing points of the river has exceptional places, themes that permit further recreation and variation of the described solutions. Filerete in *Trattato di architettura* uses analogical procedures to connote the valley Inda illustrating the Padani river sights, as an analogy that exists between the confluence of the Po and theTicino in Pavia and the sight is the form of the city itself [...] Scamozzi in the idea of *Architettura Universale* applies maths and geometrical schematizations of the geographers and astronomers to configurate a relationship between cities and the plain crossed by rivers"[2].
Prof. Martone declares "the cartographic representation, whichever type of elaboration chosen, is however an instrument of knowledge and valuation of the territory as regard synthesis of morphological, biological and anthropic data; only by this we can understand the only valuable asset of mankind which is earth, in terms of protection and safeguard"[3]. Therefore the elements that characterize the valley are the following:
- the morphological and hydro-graphic elements: ridges con-ridges, gullies terraced lakes etc...;
- the ecological elements essentially consist of tree species and herbaceous that are found in various forms on a large part of the surface;
- the anthropic elements: ridge settlers, hillside settlers, valley settlers, roads con-ridges, roads in the valley etc.

The graphical description of the elements requires some precautions, according to Nicola Surian's analysis presented in *Linee guida per l'analisi geomorfologica degli alvei fluviali e delle loro tendenze evolutive*[4] "the riverbed is represented through a path, the point of origin coincides with the relatively highest point (mountain), the extreme point coincides with the relatively lower point (sea). "A preliminary operation to the measurement of morphological parameters of the riverbed and subdivision of the water course study homogeneous morphological characteristics. [...] The sub-division in homogeneous morphological traits can take the following aspect into account:
- morphology of the valley (amplitude and confinement grade of the watercourse);
- valley direction or in plain, of watercourse;
- planimetric morphology of the riverbank, presence of natural or artificial hydrological discontinuity.

The length of a stretch is usually between 1 and 5 km"[5].
According to what Prof. Albisinni and Prof. De Carlo wrote "for the study of artificial elements we will have to refer to the stages of anthropization of the area, which suggest by themselves the main connections with its natural components. The examination of the historical events in the area allows us to retrace the crucial moments of anthropization to examine the effects produced by it"[6].
In support of the motivation that has led us to the choice to represent the Valle del Tronto with new informatic systems, it's necessary to partly expose a prepared report by the Marche Region which defines the main characteristics "The Region is characterized by the lacking presence of flat areas of a certain relevance; the plains occupy only the 11% of the territory, limited to valley floors and the areas around the river mouth [...] between the mountains and the coast an extended hilly band that declines towards the sea is included. The regional territory can therefore be divided in two orographic sectors, the first mainly mountainous and the second typically hilly. The outlined above is complicated by the presence of three bands detected and perpendicular to the evolution of the main ridge linking the Apennines to the coast. [...]"[7]. Secchi, by drafting the detailed plan for Ascoli Piceno, asserts that "La valle del Tronto is today a strong ur-

2. Giancarlo Motta, Antonia Pizzigoni, Carlo Ravagnati, *L'architettura delle acque e della terra*, Franco Angeli, 2006, pp.108-109.

3. Maria Martone, *Il disegno per il territorio*, da Quesito – Studi e ricerche per il disegno e la documentazione dei beni culturali, maggio 2007, p.90.

4. Nicola Surian, Massimo Rinaldi, Luisa Pellegrini, *Linee guida per l'analisi geomorfologica degli alvei fluviali e delle loro tendenze evolutive*, Cleup, 2009.

5. *Ibidem*.

6. Piero Albisinni, Laura De Carlo, Biagio Roma, *Un disegno per il riuso – Metodi di indagine e di progetto per il recupero del patrimonio edilizio nei centri storici minori*, Edizioni Kappa, 1983, p.31.

7. Regione Marche, Inventario e Carta Forestale della Regione Marche – Relazione generale, I.P.L.A. S.p.A, Torino, 2000, pp.25-26.

banized and infrastructured territory, economically and socially integrated, but maybe inadequately designed. [...]In the centre of the valley we distinguish three fundamental parts: the flooding plain, the embankments (...), and finally, three different types of river terraces. At a higher altitude, between the plain and the slope, just above a line across where prestigious 'villas' are found, there are two different hillsides: soft, sunny and cultivated northwards; shady, wooded and steep in the south. The agricultural activity, the fields and the vineyards design, create a regular geometrical shape on the first one , an agricultural landscape of great sweetness; while the forest and the badlands mark in more a severe and dramatic way the second one. On top of the hills one can see the villages that mark the Marchigian territory along the main and secondary ridges, in a sequence that from the mountains descends to the sea. A lot of these centres, in their recent expansion have taken on the slopes , invading them with scattered houses and small neighbourhoods, getting closer to the broad lines of communication roads and railways that run on the valley floor in the nearby industrial area projects of recent settlement"[8].

Based on what said above, the Valle del Tronto is very extended and according to scientific experiences previously analysed, we decided to limit the study to a homogeneous section of the valley, in this way the experimentation is not overloaded by the amount of data, so the analysis of the GIS representation can be more penetrating. The research is based on the medium valley, and includes the towns of: Ancarano, Appignano del Tronto, Castignano, Castel di Lama, Castorano, Colli del Tronto, Controguerra, Offida, Spinetoli.

The stretch of the valley has an extension of 20 km and it joins the Marchigian ridges with the Abbruzzo's ones along 4 km, in parallel to the course of the river Tronto.

The data are referred to the geomorphological characteristics that come from: interregional authority of the Tronto river basin and urbanistic office of Ascoli Piceno district. Some of these are in raster format and others in vectorial format.

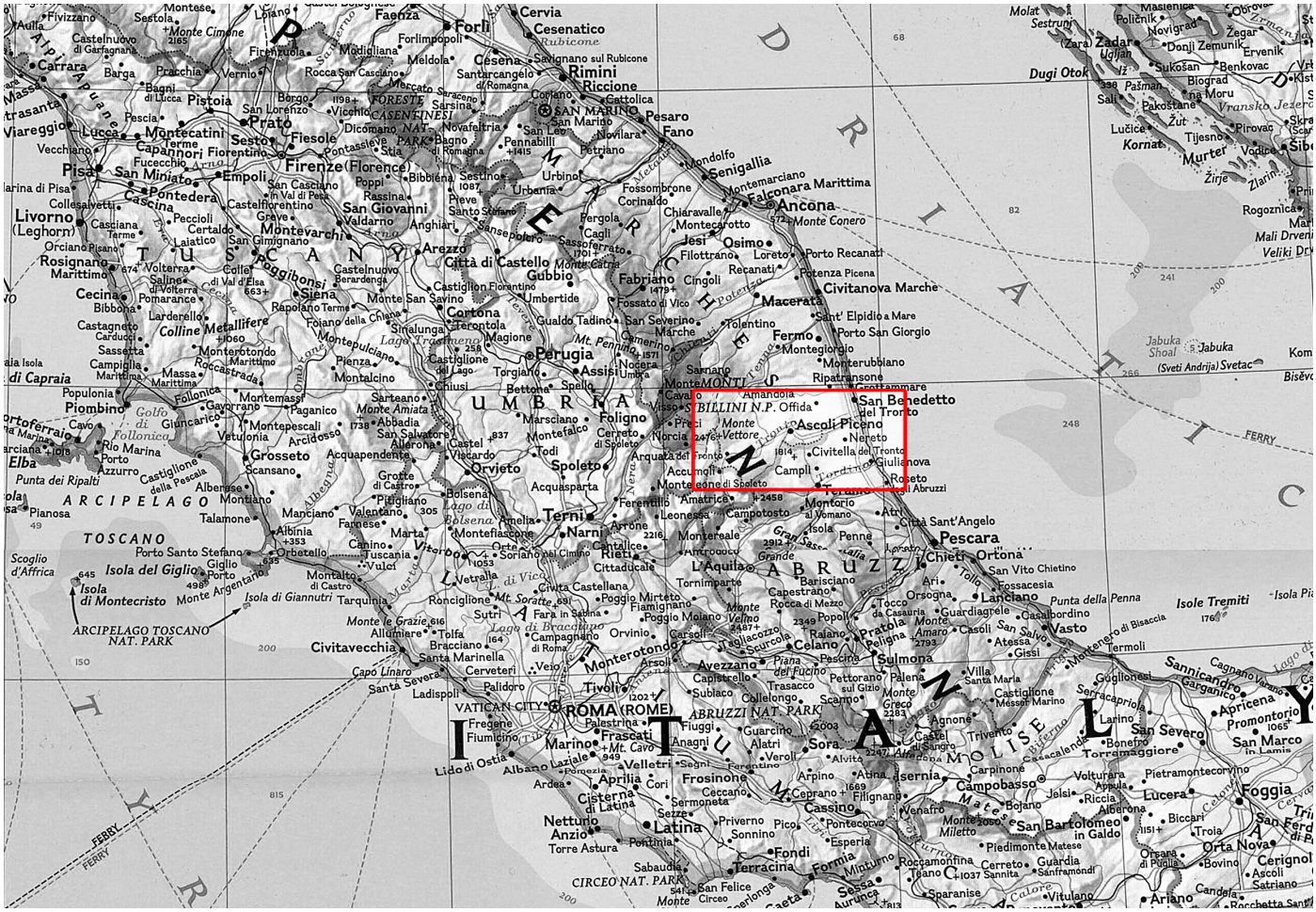

Figure 1 – Map Italy and identification of the Valle del Tronto.

The anthropic data come from a database of the municipali-

8. Bernardo Secchi, Valerio Borzacchini, Sandro D'Auria ed Alberto Monti, *La valle del Tronto: molte delle informazioni riferite a questo tipo di luogo provengono dal Piano particolareggiato esecutivo del centro storico di Ascoli Piceno*, Ascoli Piceno, 1993, pp.14-22.

Figure 2 – Photo of Valle del Tronto.

ties crossed by the stretch of valley and they are in vectorial format extracted from PRG, in a scale from 1:2000, updated approximately between the years 2007 and 2010.

As regard the ecological data it has been examined a research taken from the report "Procedure digitali per una nuova cartografia" of the Camerino University's Unity of Research belonging to the School of Architecture and Design.

Being the sources of various origins and with different graphic languages of description, every type of data was assigned a layer easy to be processed after the uploading in the GIS according to the UTM WGS84[9].

The graphic interface was realized via several applications (Autocad, Map3D, Civil 3D, Raster Design), and we recall that this operation is part of BIM concept (Build Information Modelling).

The elaboration process is based on the membership to data category (geomorphological, anthropic, ecological), however there were some exceptions depending on the knowledge of the territory.

The central elements of this elaboration was the methods of representation of the territory with graphic signs: points, (poly) lines, polygons, icons, symbols, and representation scales that better suit the data reading.

The study has interested also the definition and distinction that is between 'icon' and 'symbol' whose elements are frequently adopted in the territorial representation and often misinterpreted in data synthesis present in the GIS.

9. WGS84: World Geodetic System del 1984, è un datum molto diffuso e viene essenzialmente utilizzato per i GPS (*http://www.sharpgis.net/post/2007/05/Spatial-references2ccoordinatesystems2c-projections2c-datums2c-ellipsoids-e28093-confusing.aspx, articolo di Morten Nielsen*).

The elaboration of the geomorphological model is distinct in two phases: the construction of an orographic three-dimensional model and the two-dimensional representation of the valley stretch, seen under the appropriate scales.

Since the orographic model of the River Tronto is in scale 1:10000 and CTR of Abruzzo Region is in scale 1:5000, the unique scale 1:1000 was used for two reasons firstly for the elaboration time, secondly for the quantity of data used, in fact the stretch of valley has a surface which extends mostly into the side affected by the CTR of the Authority basin of the River Tronto.

The elaboration three-dimensional of orographic model has been done with isolines and spot heights.

Geometrical anomalies were eliminated, TIN and successive GRID models were created.

The TIN model can be seen from a scale 1:5000 (without having difficulty for the geometries that outline geomorphological characteristics).

Some representation styles were applied to TIN model in the software, for example: the triangles of slopes, the colour scale of the slopes, the cloud of points, etc... .

Based on the type of style given, some considerations have been made: up to which scale of visualization the data are readable, if the style used is adequate for understanding of the geomorphological features, if improvement and balance of representation to the specific analysis is possible, and so on.

From the results obtained on the model, we understand that some styles are bound to the

visualization scale and hence of reproduction; other charac-

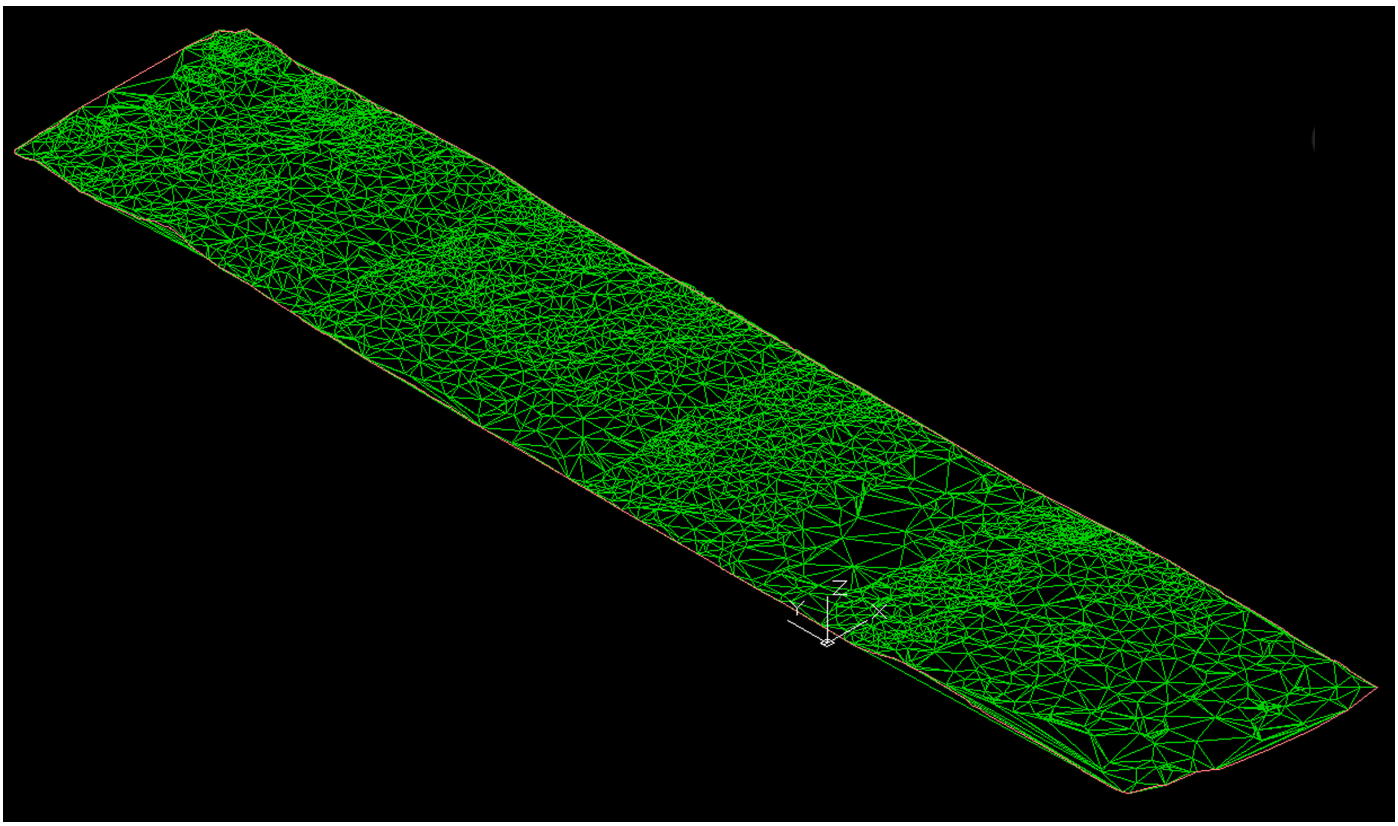

Figure 3 – Representation of the TIN surface through the Civil 3D software and the awarding of the style “triangles”.

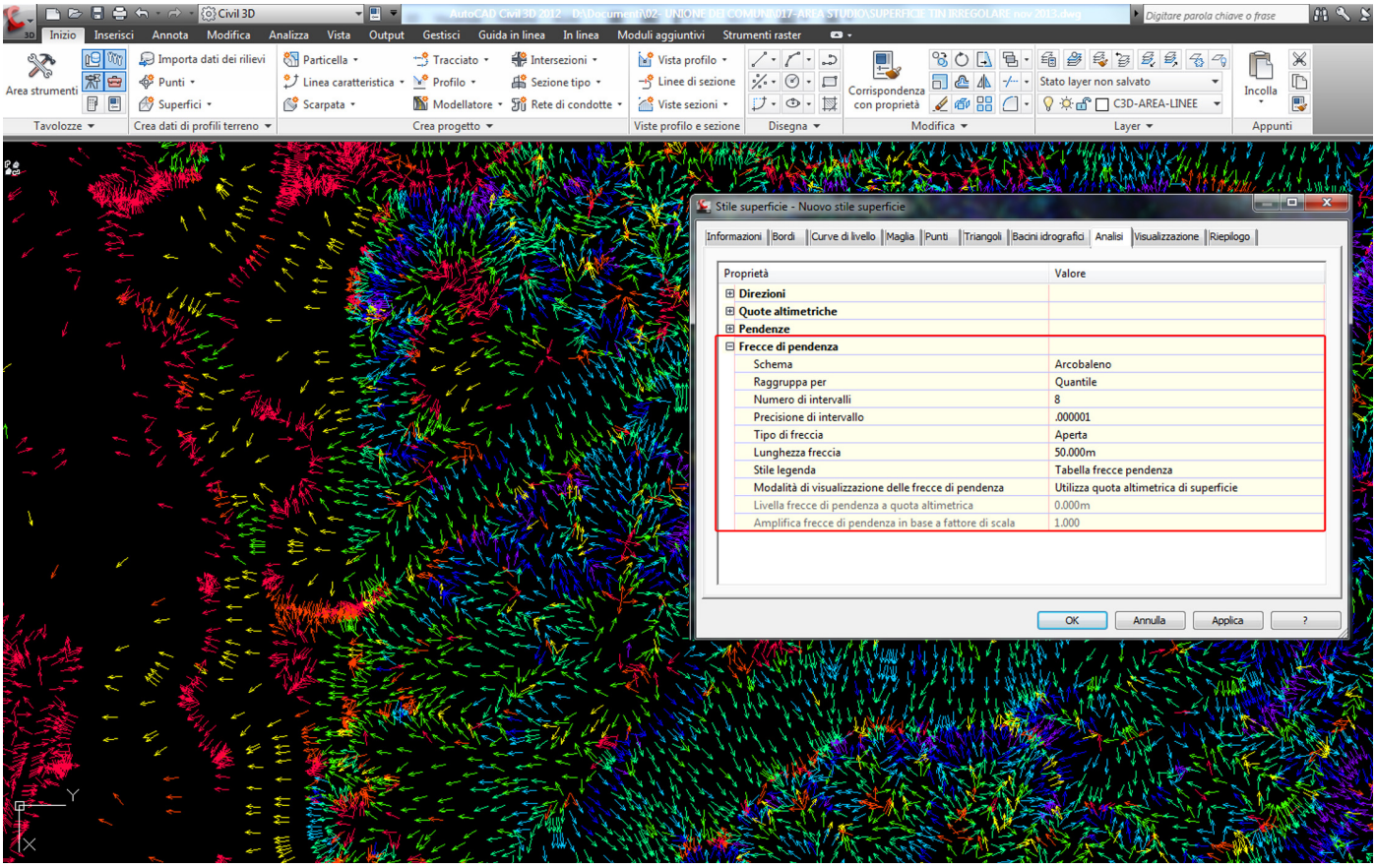

Figure 4 – Representation of the TIN surface through style “slope arrows” in Civil 3D software.

teristics are clearly visualized from a certain scale on.
The GRID model comes from the elaboration of the TIN model: the mesh of triangles, triangles was regularized to 5 metres on each side, the choice depends mainly on the managing files with the software. Indeed, implementing the mesh dimension, the time of data elaboration is greater and the definition remains "the same".
The WGS84 was associated to the GRID permitting other data with the same coordinates to connect, some visual styles previously adopted for the TIN were applied and finally profiles were extrapolated perpendicularly to the axis of the river. From this the visual styles assigned previously to the TIN were incomprehensible for the GRID, the file extrapolations is significant for the reading of the slopes as so for the choice for the definition scale, that in automatic way consents to read the peaks and the depressed areas.

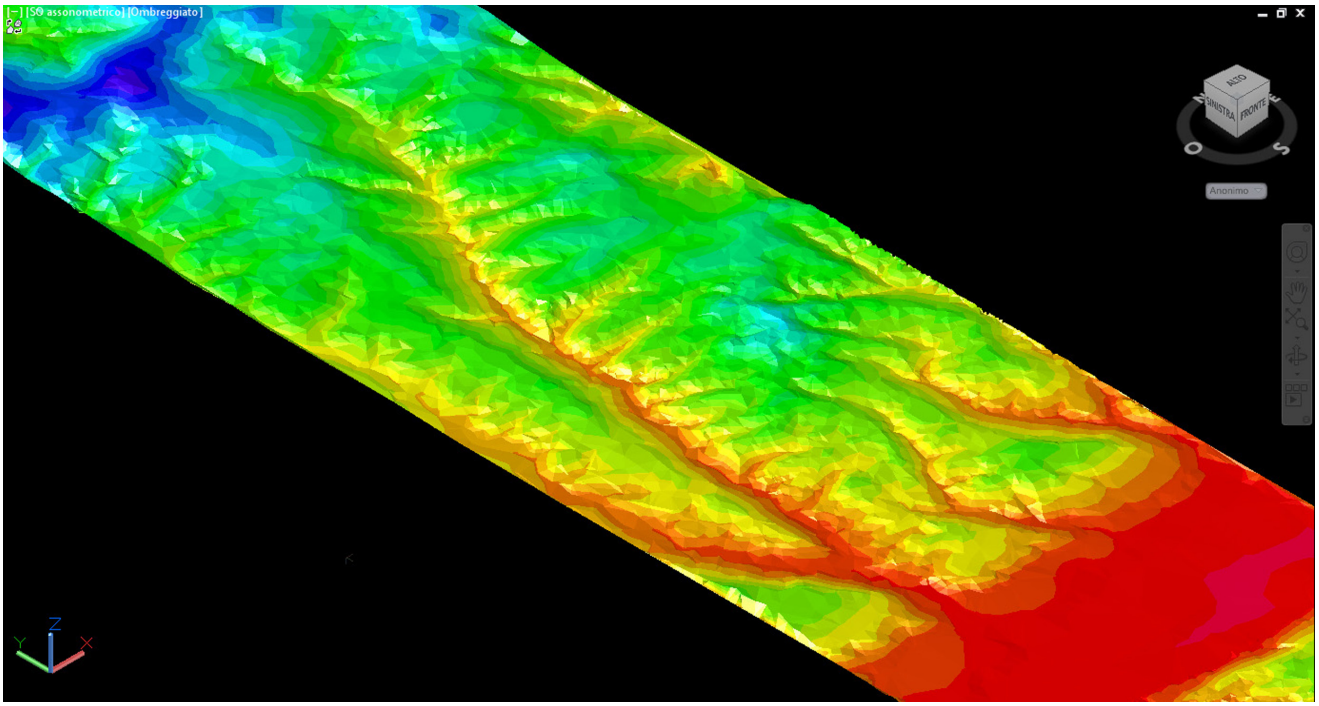

Figure 5 – Isometric representation of the TIN assignment with the style "color scale gradients".

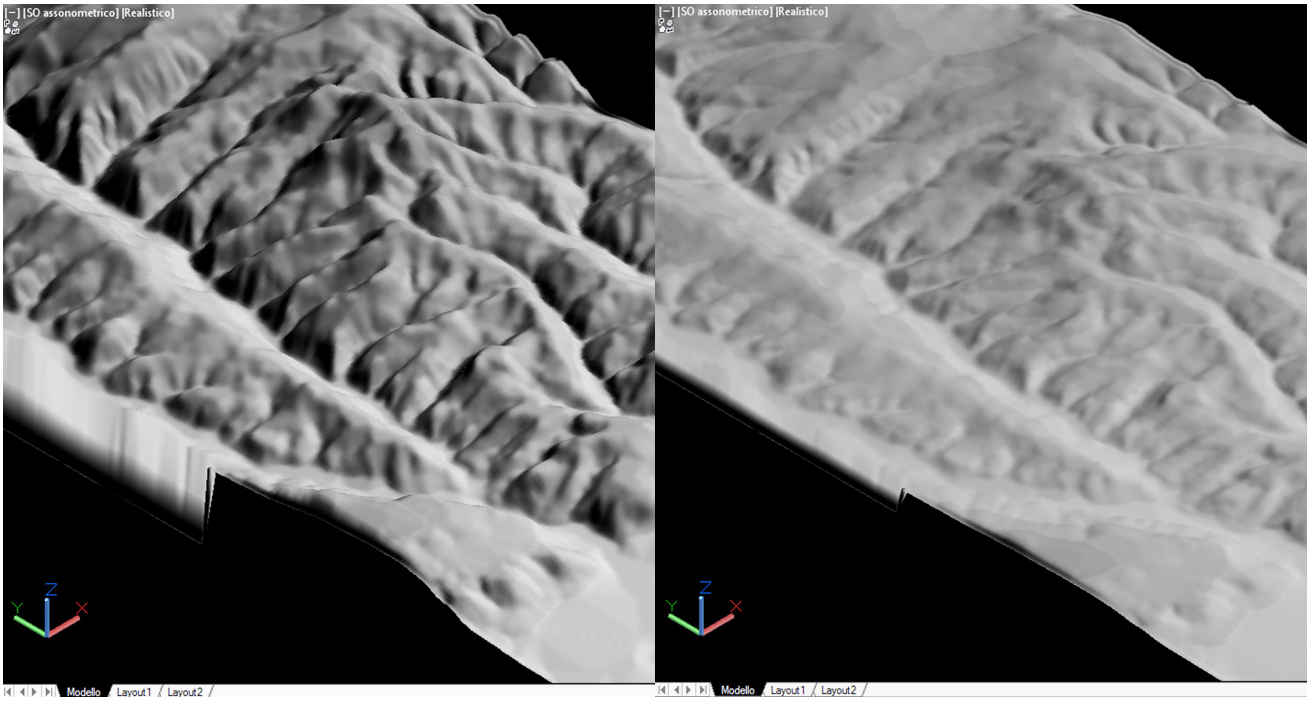

Figure 6 – Representation of the DEM with the color style and emphasis on the elevation. Both views are isometric and the same display scale.

The DEM was produced from GRID, which being a raster image is visualized as a surface, however the last Map3D version consents the visualization in 3D and to control the elevation quotes. It's possible to associate a visual style to the DEM with an overlap of a colour scale in which bands depend on the altitude interval chosen.
In this experimental phase some analysis are pointed out: to which scale of visualization.
One clearly reads the data, which styles of visualization are really necessary to comprehend the orography, which new styles permit to improve the data reading. From the tests made we can see that the DEM image can be visualized up to a certain scale magnification beyond which is not possible to understand the data, the definition in this case depends on the elaboration that is made in that moment from the data.
By addressing the parameter style it's necessary to specify that in the software Map3D we visualize DEM from both 2D and 3D point of view: this setting is important to distinguish the depressed areas with respect to the peaks.
The next passage of the experimentation was the georeferencing of the orthophoto map, firstly the technical characteristics of each table: image dimension is approximately 13500 x11000 pixel and graphical resolution of 500 pixel/inch.
The tables concerning the stretch of valley have been assembled in succession. Before saving the file in jpeg, more trials have been made that would permit an easy elaboration in Map3D.
The software used for the georeferencing is Raster Design.
After assigning the coordinates to the image, it has been connected to the GIS system.
The most interesting result is given with the three-dimensional view, in fact the image is positioned exactly on the DEM surface, so that one can read the orography and anthropogeography.
In the three-dimensional view the data is clearly visible only for rather small scale displays.
As, for example, the scale 1:25000, for the bigger scales the orthophoto paper image is undefined. To overcome the problem it is necessary to modify the image resolution jpeg at the expense of processing time.
The two-dimensional geomorphological model is realized with cartographic CTR information.
An important contribute is given by the publication of "*Un disegno per il riuso",* in which interesting thematic maps of topographic characteristics of the valley of Aniene have been designed[10].
The geometric entities behind the 2D representation in the GIS are: points, (poly)lines, Polygons and each sign has been associated to a style.
The choice of each parameter that defines the style needs to perform various tests in order to solve the questions associated with the scale of visualization and representation. In the

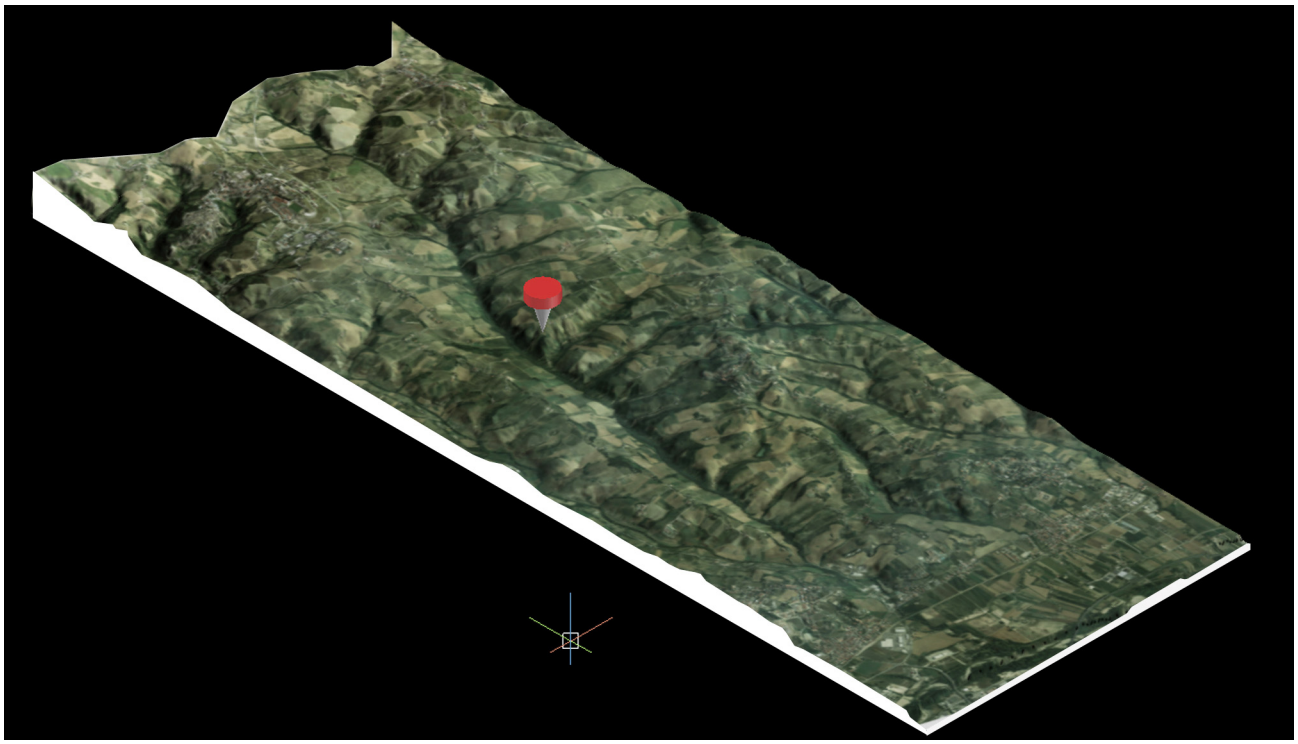

Figure 7 – Orthophotos displayed through isometric view. The sharpness decreases as the display scale, this is due to the type of image resolution orthophoto.

10. Laura De Carlo, Piero Albisinni, op.cit., pp.28-30.

two-dimensional representation data in vectorial form are present while the raster images have been excluded because of the long elaboration times.
A parameter that is often overlooked but that affects the data representation, especially if placed in two-dimensional view, is the background colour on which the geometrical elements are designed, even if in this case it is necessary to perform more tests to obtain a comprehensible representation.
Another difficulty for the clear reading of geomorphological elements depends on the number of visualized information to a scale of representation and the type of sign used; In fact the isolines can be read on very big scales (from 1:2000 to 1:10000), the tops and/or ditches can also be read on reduce scales (from 1:2000 to 1:50000).
In the construction one must decide which data to visualize and possible overlaps. This shrewdness gives the model a way of being clear and makes the choice of the scale of visualization easier because data of the same entity and definition can be reunited in one screen.
In the two-dimensional representation there are orographic

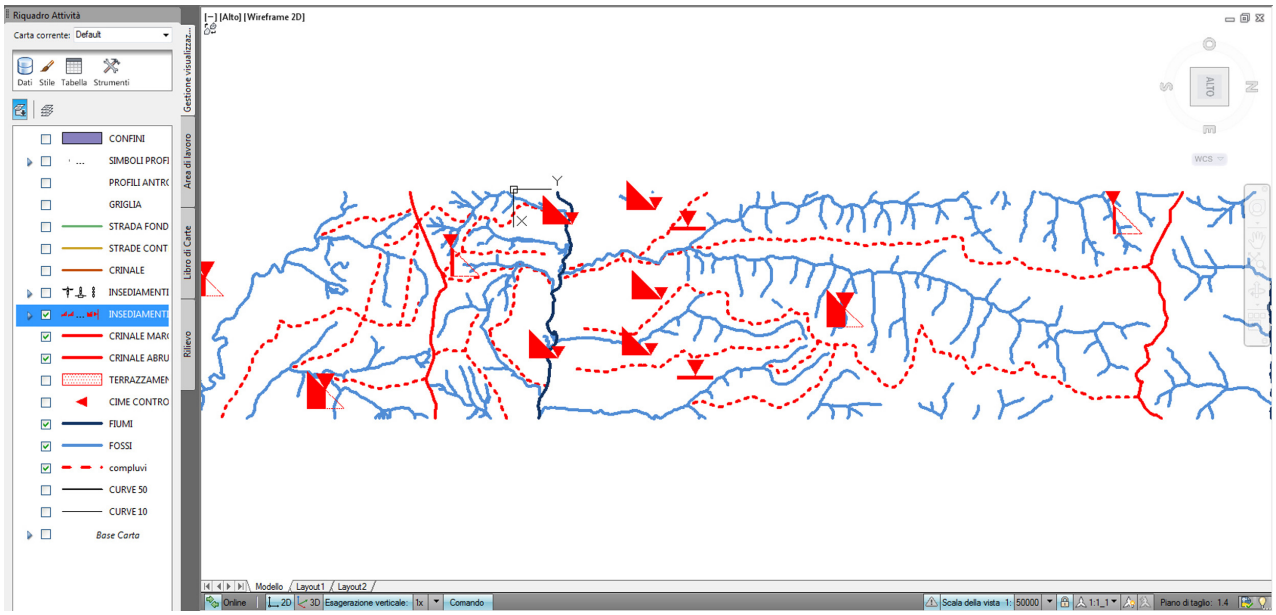

Figure 8 – Graphic of orographic and hydrographic aspects of the study through a graphic obtained with signs and symbols (display scale 1: 50000).

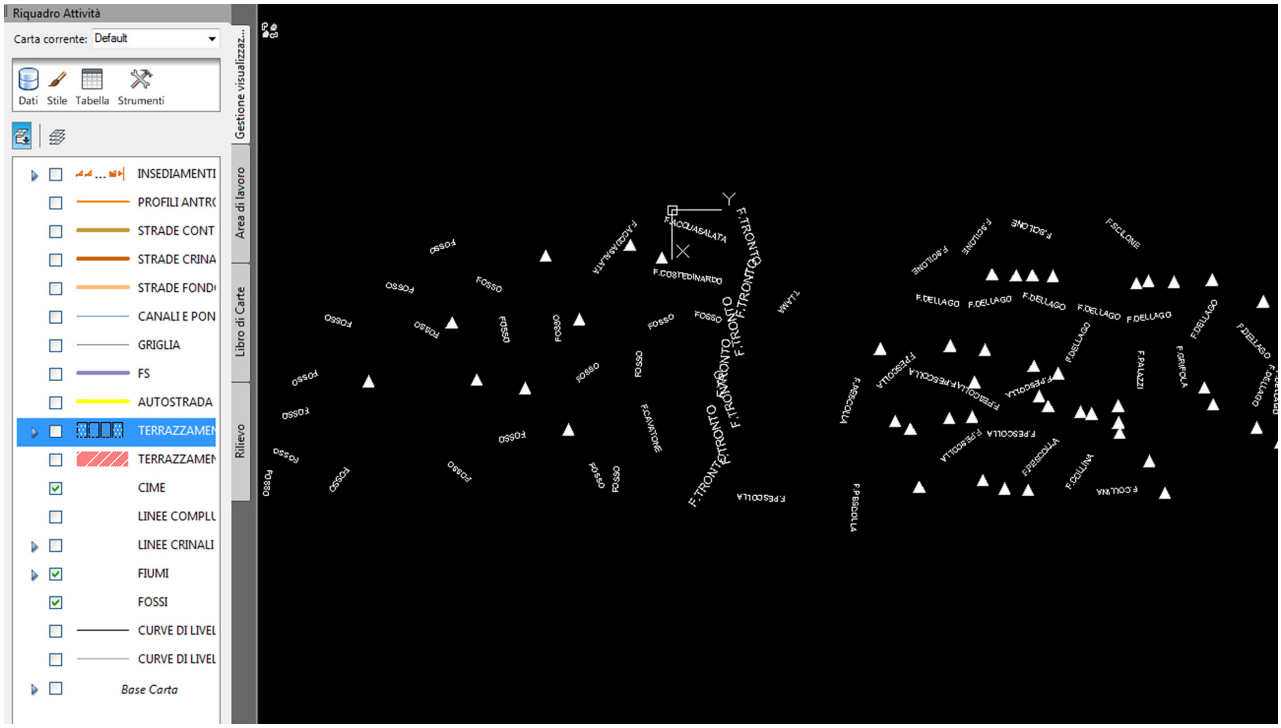

Figure 9 – Processing of graphic character orographic and hydrographic of the study area through representation for signs and symbols on a black background (display scale 1: 50000).

data and hydrographic data.
The orographic data are described by isolines and symbols support the description of the items, as, for example, the tops, the ridges, the compluvium and terracing.
The use of the sign as a representation of some geomorphological elements, has been fundamental for the description of heterogeneous data.
The hydrographic data are described across lines and assume a different style depending on the meaning (river, torrent, ditch).
In the case of hydrographic data described with lines, the problem with the scale visualization is determined by the thickness of the sign: in fact some lines in reduced scales are thin and incomprehensible, therefore a range scale is necessary to be fixed.
In the two-dimensional representation as well as the design plan view of data the design of the orthogonal profile axis on the river Tronto was included: this allowed to read and to comprehend the relationships underlying between orographic, hydrographic and urban settlements.
In the GIS attributes are associated to the data: identification code, geometrical information and other indications formulated by the system user, hence, once defined the geometrical data, the next step is the formulation of topological data and the formulation of spatial queries that show the characteristics of the territory.
The GIS responds to the queries formulated by the user indicating the element corresponding to the answer on the map, assigning to them a colour and type of sign to be recognized with respect to other geometrical data.
An important moment for representation in the GIS is the description in signs of settlement characteristics.
The aim of this experimental part consists in verifying different types and ways of analysis even in function of the different representation modalities.
In the text "*Un disegno per il riuso"* the choice of "an area that comprehends three systems of valleys [...] that mainly qualify the territory with its specific infrastructure characteristics [...] and the topological relationships of urban areas"[11] has permitted to organize the settlement systems in: linear schemes (also known as zone of Acropolis with medieval origin) or radial scheme.
"A classificatory operation of this type involves such a degree of schematization that we cannot consider the many variations of the relationship between edification and site that determines the identification of such urban reality"[12], so these considerations have allowed to reorganize the elaboration phase of the anthropic model.
Observing the morphology and studying the historical stages of the populated areas, the principal characters that define the anthropic model were identified as well.
Amongst the studied texts to individualize the settlement signs of the valley stretch analysed, the book of Luigi Piccinato "*l'Urbanistica medioevale"* says that "the typical configuration of the ground, on which many towns have arisen from X to XIII century in the area of Italy identified with Lazio, on the promontory resultant from the confluence of two rivers or torrents strongly recessed in the ground, has created a very common and interesting type: what we could call 'zone of Acropolis' (*fuso di Acropoli*). Which really isn't an exclusive characteristic of promontory cities, typical situation of Lazio Umbro-Sabino, but also many more urban creations of Tuscany and Marche from IX to XI century, set on the hills of elongated shapes, therefore orographically similar to those of citadels of Lazio. Many of these have then been set on abandoned Etruscan citadels for centuries; on the ruins they have reclined, and have taken, with the position provided, the city walls and maybe also the road schemes"[13].
The description of Piccinato clearly shows how the first settlements were collocated on the valley sides, thus across the orography of the territory, the first urban centres were conformed.
Another important evaluation on the Marchigian settlements is given by Sergio Anselmi in the Marche volume of the collection "l'*Architettura popolare"* in Italia in which he states that "[...] such phenomenon is because of a settlement structure development, in which the original conformation of the natural environment and the economic and social process who preside the transformation are related, at least in some historical phases, in a very singular way. [...] It's feasible and historically established the consideration of the Marche as one of the areas in Italy that has assumed in time [...] a polycentric organization and dimensionally articulated in each of the territorial areas – coastal, hilly and mountain – and across the numerous valleys, that with limited amplitude and variable depths, flow out perpendicularly to the Adriatic coast. [...] the prevalence of the agricultural economy, partly tied up to the modern times [...] has affected the development of the Regional territory, preventing the formation of urban centres of economic and demographic dominance, *favouring* [...] t*he growth of small and medium centres*, characterized by a diffusion of decorous buildings, by an unusual medium quality of the artefacts and, [...] by a wide selection of services and infrastructures"[14].
From the reflections mentioned and from the observation of historical maps, it emerges that the urban shape of the first

11. *Ibidem*.
12. *Ibidem*.
13. Luigi Piccinato, *Urbanistica medioevale*, Edizioni Dedalo, Bari, 1993, pp.28-29.
14. Sergio Anselmi e Giovanni Volpe, *L'architettura popolare in Italia - Marche*, edizioni Laterza, Bari, 1987, pp.11-14.

settlements, that is the one of the ridge, have maintained its original characteristics.
The settlements of halfway and valley bottom, according to the study of historical maps, are supposed to be born around the year 1816 and that, only after an intense rehabilitation and improvement of the infrastructures, have been expanded as well.
The experimental phase, having as object the elaboration of the three-dimensional *model of anthropic data,* is characterized by the relation of the DEM surface with the principal elements of anthropization (urban fabric, infrastructures, emergencies, etc).
The procedure began with the realization of a new GIS document, inserting the DEM surface used for the 3D geomorphological model and the representation of schematic volumes of urban fabric present in the stretch of the valley analysed.
The volumes obtained are the result of an accurate comparison with the informative material. The final elaboration defines the dimension of the stretch of valley chosen, the informative scales available, and the set goals, therefore it was decided to limit the visualization of the data up to the scale 1:5000, because further enlargement would have determined time and ways of elaboration different from those established.
The result is not adequate to the expectations: the identification of the historic centre, the urban expansions occurred outside the walls, the principal routes linking urban centres, the micro centres that partly occupy the agricultural land, etc. As a consequence, another model with the help of three-dimensional symbols (different because of colour geometry and dimension) which represents in the best possible way the characteristics of the settlement has been designed.
Another passage was the joining of the signs to the DEM in the GIS.
In this case it was necessary to make dimensional changes to have a clear reading even in smaller scales (1:10000, 1:20000, etc).
Regarding the infrastructures, the elaboration of the three-dimensional model was focused on the historical roads (those that have signed the anthropic process).
The representation of the infrastructures in the three-dimensional model, is obtained by lines, to every type a style was given and this has allowed to easily identify information in the overlap of the DEM. After the elaboration, there was a careful observation of the isometric views and of the repre-

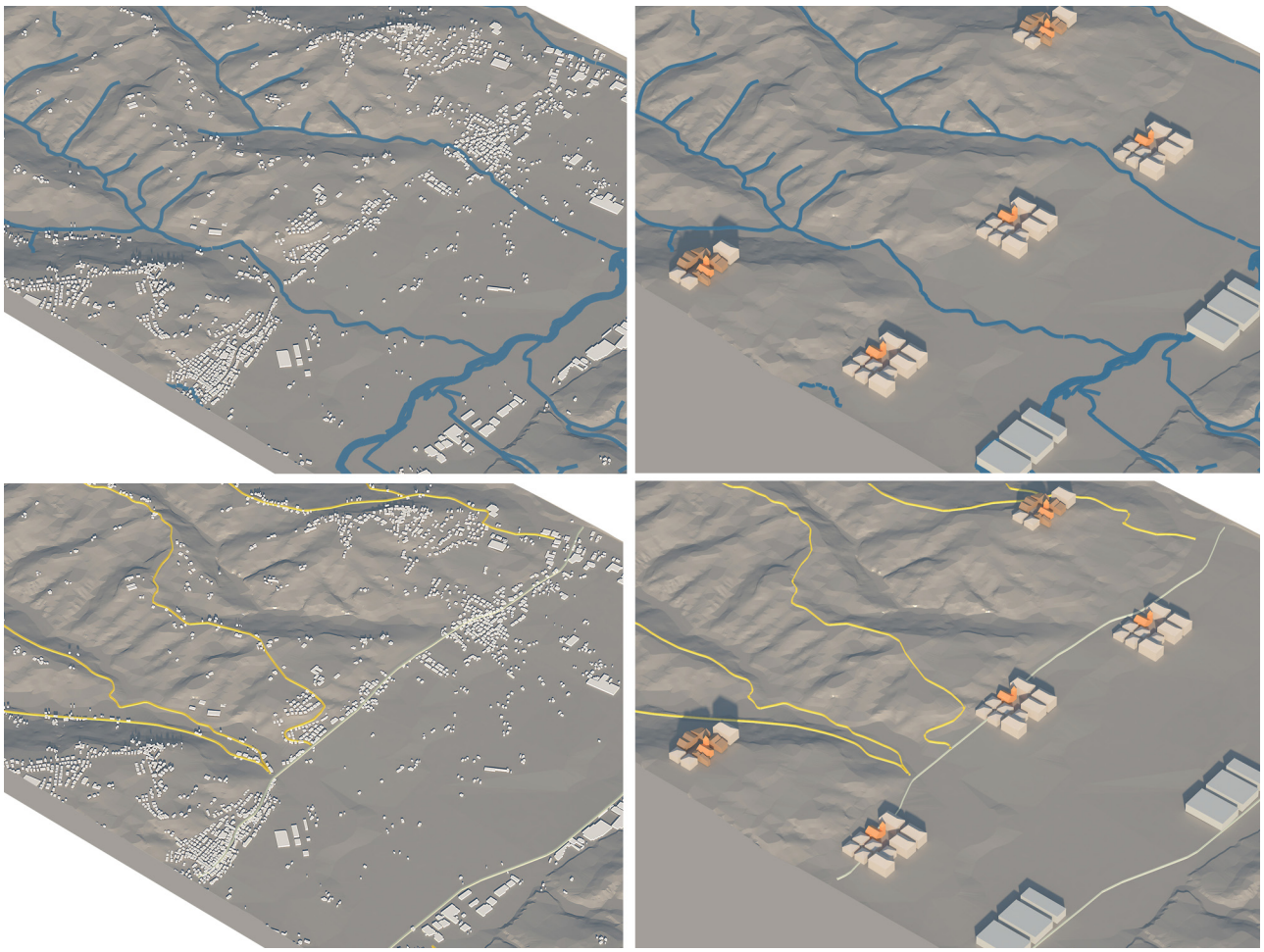

Figure 10 – Isometric representation of the TIN, the cubic building, three-dimensional symbol, watercourses and road axes to different display scales.

sentation scales so as to identify the scale range within which the display of data was efficient.

The two-dimensional representation is intended as a view from above, however to this reading the representation profiles, already used for the 2D geomorphological model, were reckoned, in this case the symbols of the settlement centres were added, because the relationship between these two is very strong.

Amongst the various goals set in this phase there is the demonstration that the type of representation chosen and the definition scale influence the efficiency of utilization of the GIS.

If the representation made with the GIS is dynamic and in continuous growth, the communication of the information can result inadequate for the knowledge of the territory, as object of study. The construction of image of synthesis has in fact introduced a new condition in the representation of elaborated graphic, such as the elaborated model with the informative systems become adjectives to the model of reality and its representation becomes the application. Indeed it is possible to manipulate the model and make different types of representations functionally expressive to the different analysis.

The graphic representation has kept in consideration all the characteristics.

As already done for the geomorphological model, some anthropic elements have been translated in graphic symbols, mainly in the case of data visualization on a small scale 1:20000.

The queries were associated to the two dimensional model which help to know the anthropic information in a simple and automatic manner.

For the ecological category mainly characterized by the use of the land, the research studied was "*Procedure digitali per*

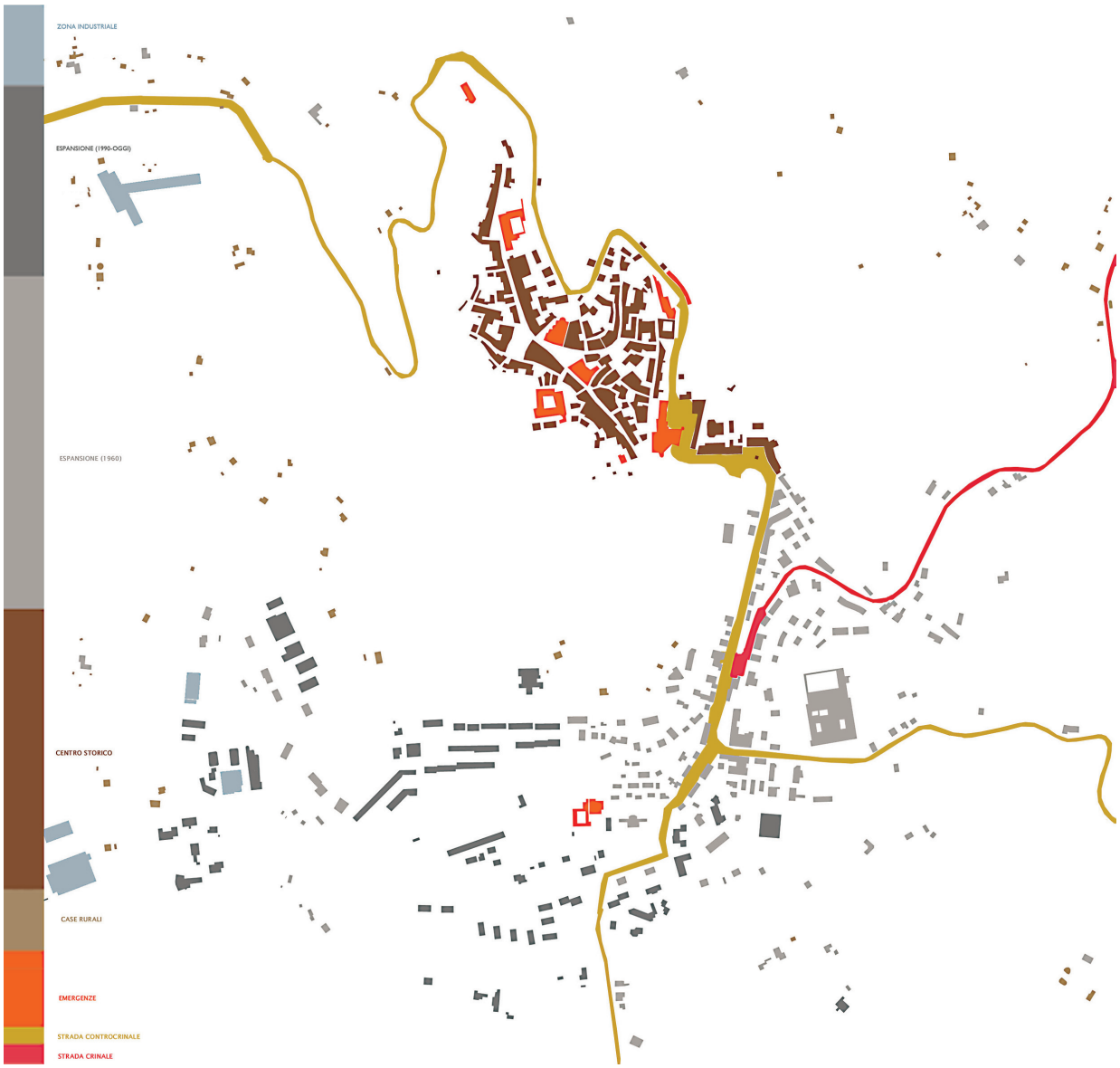

Figure 11 – Ideogramma gave the example of anthropogenic (detail of the settlement of the ridge of Offida).

una nuova cartografia" by Serena Sgariglia [PRIN 2006][15]which has part of the stretch valley examined as a case of study .

The research "proposes to illustrate some procedures identified through specific experimentation, in which the GIS open source chosen have been forced and folded with the purpose of producing accurate cartography in detail, from the different themes and different scales , integrating therefore traditional representation systems with new representative modalities. [...]

Amongst the different possibilities offered by GIS technology there is the one to make the historic cartographic documentation more comparable with the up to date ones, made of substantial importance to understand the transformation of anthropic space and therefore each process of knowledge and development of the environment. In this direction the reasons of the experimentation described is to be traced ,its goal was also to build a geographic documentation project which detailed the ground use in the territory of Appignano del Tronto and to highlight some of the identifying characteristics of the share cropping landscape"[16].

The study is composed of elaborative and cognitive phases, being the motivations of the choice of this area --- based on "valuation of different nature, that is integrating the relative data in support of physical-orographic, with those of geological nature, and with those of ground use"[17]. Following the description of the research we learn that "the first operations conducted concerned the georeferencing [...], working on the union of the eighteen maps that define the area of study[...] It was evaluated that the possible error coming from the video union of historical maps could be however comparable with that of the choice of adopting the Regional Technical Map with a scale of minor detail, therefore theoretically which much less accuracy"[18].

A further elaboration phase of the research regarded "the video digitalization of every single Particle using the QGIS software"[19].

A very laborious operation was the path trace of cadastral parcels across the Gregorian cadastre sheets, and subsequently filling the attributes table and the transformation of the perimeters of the rateable particles in areas across the inclusion of the centroids (operation which consents the connection between vector files and spatial database).

Sgariglia claims that "the data of major interest inserted for

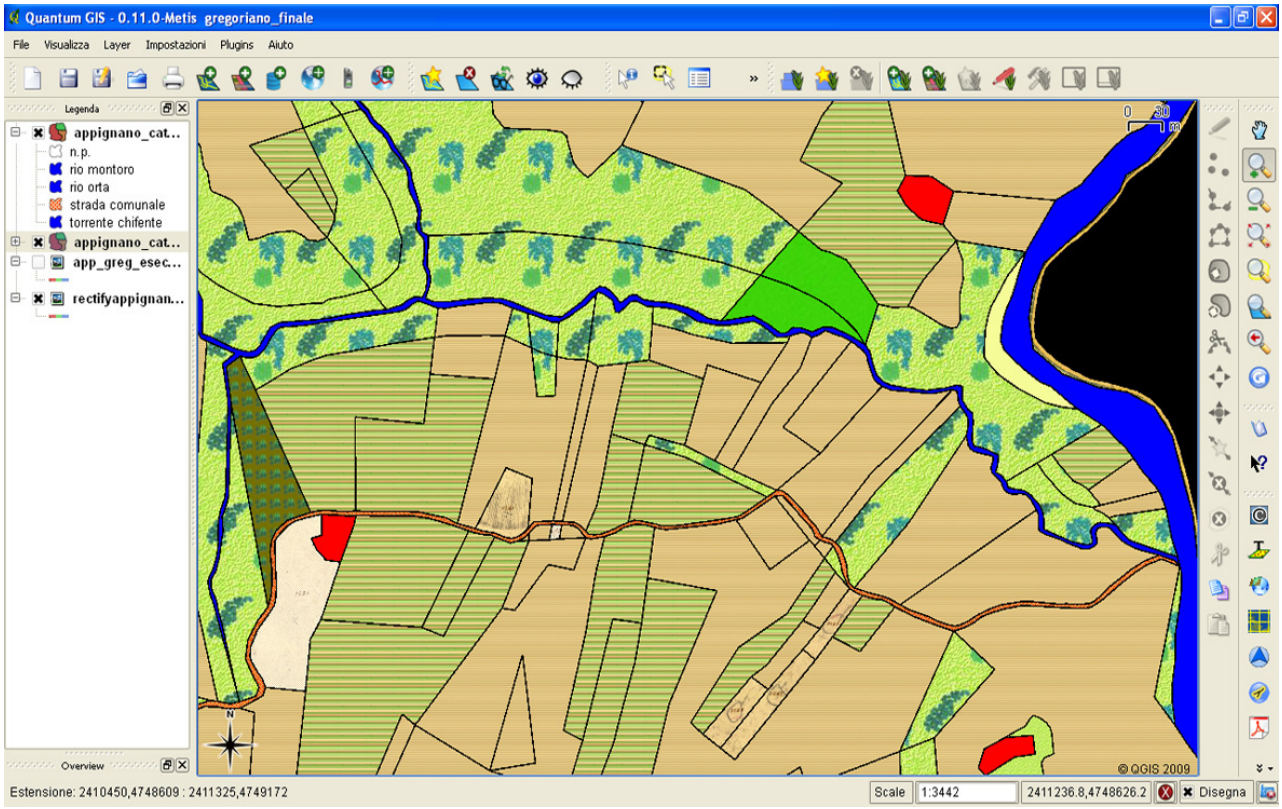

Figure 12 – Particularly the Charter issue of land use: the open space. The polygons are related to the built up in red, blue streams, the different uses of soils are presented with different textures.

15. Pubblicazione PRIN 2006 dal titolo "*Sistemi informativi integrati per la tutela, la conservazione e la valorizzazione del patrimonio architettonico e urbano*", coordinato dal prof. Mario Centofanti, p. 292-301.

16. *Ibidem.*

17. *Ibidem.*

18. *Ibidem.*

19. *Ibidem.*

the research has been the one relative to the use of the land for open spaces and to the building characteristics for the construction in the historic centre. In the first case it has been possible, using some of the simplified software features QGIS (of which in particular the ones dressing the cartographic space that consent the importing of punctual symbologies and personalized colour polygonal backgrounds) elaborate thematic maps in analogy with graphic modes of *cabrei* (collection of maps) and land registers of Marchigian history"[20].

The work done on the analysed research was very complex because it gives significance to enrich the Marchigian database regarding the use of the ground, the building appliances and of the infrastructure of the roads; the database Abruzzo had to be simplified by grouping some of the themes considered similar.

" [...] Created a single structure both for different vector layers and data base, after having them populated, an operation of patch files vector was processed , to recompose in a single cartographic project describing the entire valley transept [...] the image obtained indicates that the cartographic homogeneity corresponds to a non homogeneous o landscape of the two regions, where the Marchigian one is characterized by a regular design of the ploughing fields, while in the Abruzzese one the anthropic presence is less significant"[21].

In conclusion, this study was useful to represent a territory of a complex reality, multiple aspects are analyzed to come to a qualitative and quantitative mostly exhaustive comprehension. It means also to reproduce the current status and the history of the territory, the birth and the phases of its evolution that have modified it through the time.

Such a complex analysis needs to be referred to skills and fields of different studies that can lead to specific elaborations either detailed or partial[22].

Therefore, one of the main themes in the representation of the territory is to provide evidence of this , taking advantage of different analytical contributions but defining a "system" of unitary representation.

The territory representation is intended also as a construction of a relation system made of signs and graphic languages in which collocate data and build information aimed at the documentation, knowledge, management and protection of the territory.

The GIS has favoured in this sense the territorial representation responding to the request of a complex description of the places, to the in-depth analysis of the scales, however in the "classic" representation there is a discretion between the graphic language and communicated information that favours the data legibility. In the GIS the management of multiple data does not always coincides with an efficient representative, mainly for the frequent skips of the reading scale of a territory portion.

These problems emerged in this research trip.

To study the geographical valley system, a reduction and a simplification through models that could entirely describe it were made.

The final model is therefore the re-composition of data of the geographical system, by means of a new system which realizes a more efficient graphic communication suitable for the complexity of the description.

20. *Ibidem.*

21. *Ibidem.*

22. Shannon McElvaney, *Geodesign. Case Studies in Regional and Urban Planning,* Environmental Systems Research Institute, 2012.

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