TERRITORIAL ANALYSIS BY MULTISPECTRAL REMOTE SENSING: THE VENICE LAGOON BASIN AND ITS HINTERLAND AS A MODEL TO PLANNING

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Commission VI, Working Group 3

KEY WORDS: Physical Evolution, Human Settlement, RS-Analysis

ABSTRACT

Territory is a dynamic system characterized by continuous physical and anthropical transformations which give rise and/or destroy natural and cultural resources.
The present cartography, therefore, is often not up-to-date at the moment to realize any land use project. Consequently the thematic maps, which are the mean support to planning, would need a systematic revision practically unsustainable from a point of view of cost and time.
The problem of this up-to-date operation seems to be resolved using the Remote Sensing multispectral image analysis, by which it is possible to interpret and recognize the territorial phenomena, following and controlling in the meantime their development trends.
The flash on the Venice lagoon system is an example of the informative potentiality of this analytical method, by which the signs of the change territorial processes are put in evidence. The export of these signs into an up-to-date topographic support is practicable because the interpretation is developed on previously georeferenced images.

Since 1985 the L.A.T. (Laboratorio per le Analisi Territoriali), Padua University, has pointed out a new approach to analyse on-time the different territorial Systems, aimed at the study of planning models.
For this purpose Remote Sensing methods are used, a research field in which the Lab is actually an advanced school.
At present the thematic maps are considered the basic tools to planning. Photogrammetry contributes to them being the necessary support to localize exactly all the measures and geometrical parameters acquired on the field by the specialists.
Therefore, it is evident the physic and anthropic contents of this maps show a picture of a static territory, fixed at the moment of the information survey often recovered at different times and by experts each other uncalling.
One says, instead, each territorial system is characterized by a continuous and more or less quick transformation which produces and destroys natural and/or cultural resources.
The thematic cartography therefore is unsufficient and not up-to-date for a correct planning because lacking on-time any information about the change processes and the trends of their migration on the territory.
Consequently it is clear the territorial dynamics becomes the primary element to formulate every land use project, based on the forecast of the eventual risks or crisis of the system. Such a knowledge is possible only putting out the physical and anthropical phenomena and their interrelations on which the human interventions may cause unbalances and/or hazard states.
So, the traditional thematic maps to be useful would need a continuous and systematic revision, but this is practically unsustainable because of the long times and the high costs of the survey operation.
What is the methodology and the technical approach to obtain on-time such an aim? What are the means to control the fall-out and the efficiency of a territorial planning during its carrying out phase?
The problem may be resolved making use of the Remote Sensing analysis, that is interpreting multispectral and multitemporal satellite and/or aerial images. By it, indeed, one can recognize and follow step by step the evolution of the phenomena and of the dynamic processes characterizing a region, controlling in the meantime their development trends.

An example of the informative potentiality of the Remote Sensing method is showed by the following flash figures 1, 2 and 3, regarding the Venice lagoon system and its neighbouring continental hinterland, each of them different for physic characters and velocity of transformation.
The analysis, still now in progress, was finalized to reconstruct the links between the territorial change characters and the typology of the ancient human settlements in relation with the available natural resources.
Of course, the final purpose is to individualize on the territory the archaeological remains, more often buried, to safeguard them against the present spread and casual anthropic interventions. The resulting framework emphasized two different land use models of planning, that is: global, in the fluvial plain of the hinterland and diffused but not random in the lagoon basin.
The export of the signs derived by image interpretation into a topographic support is technically practicable. The interpretation, indeed, is always developed on previously georeferenced images, so that the transfer becomes a normal routine work.

REFERENCES

BAGGIO P. 1983. Anamnesi del territorio veneto: modello di organizzazione romana nell'uso integrato delle risorse naturali. Quaderni Ist. Arch. Urban. Univ. Padova, 2, pp.35-47.

BAGGIO P., GAFFARINI P.M. 1991. Geological investigations on a seismic region: a Remote Sensing methodology aimed at a detaild zoning for a correct planning. Proc. European Symp. C.E.C. "Science, Technology and Cultural Heritage', Bologna 1989, pp.40-45, Buttenworth-Heimann, Oxford.

BAGGIO P., PRIMON S., 1997. Il sistema lagunare veneziano. Modello di evoluzione fisica e presenze antropiche antiche. Atti Ist. Veneto Sc.Lett. Arti, Venezia (in printing).

BAGGIO P., SIGALOTTI G.B., 1991. IRT-Remote Sensing analysis to locate archaeological sites in the Strait of Messina area. Its role in the bridge preliminary project. Proc. European Symp. C.E.C. "Science, Technology and European Cultural Heritage, Bologna 1989", part H, pp.885-893, Butterworth-Heimann, Oxford.

BAGGIO P., SIGALOTTI G.B., GAFFARINI P.M., PRIMON S., ZAMBONI C., 1994. Ancient anthropic systems in the Sibari territory (Calabria). Identification of the interesting areas from a cultural point of view through the implementation of settlement models. Proc. 3th Int. Symp. "The conservation of monuments in the Mediterranean basin", Venice, pp.25-29.

Figure 1: **Venice lagoon basin and its hinterland.**
The territorial evolution of the Piave River. From a satellite SPOT1 image, Bd1, 2 and 3: the interpretation of the fluvial palaeo channels shows their West-East Quaternary shifting. (a) = Lower limits of the fossil alluvial fans; (b) = Series of the recent progreded coast lines. *Red linears* = faults and/or fractures buried below the fluvial plain. These lineaments are the effects of neo-tectonic moviments which caused the shifting fluvial dynamics.

Figure 2: **Venice lagoon basin and its hinterland.**
The trends of the Piave River evolution. From a satellite SPOT1 image, Bd1, 2 and 3: this scheme is derived from the interpretation put in evidence in Figure1.
Broad arrows = West-East shifting trends; *normal arrows* = North-South trend deviation to the subsident lagoon area. This morphological framework has sprang from a tectonic basin bounded by faults (Montebelluna f. = Mb; Caorle f. = Ca; *red lines*).

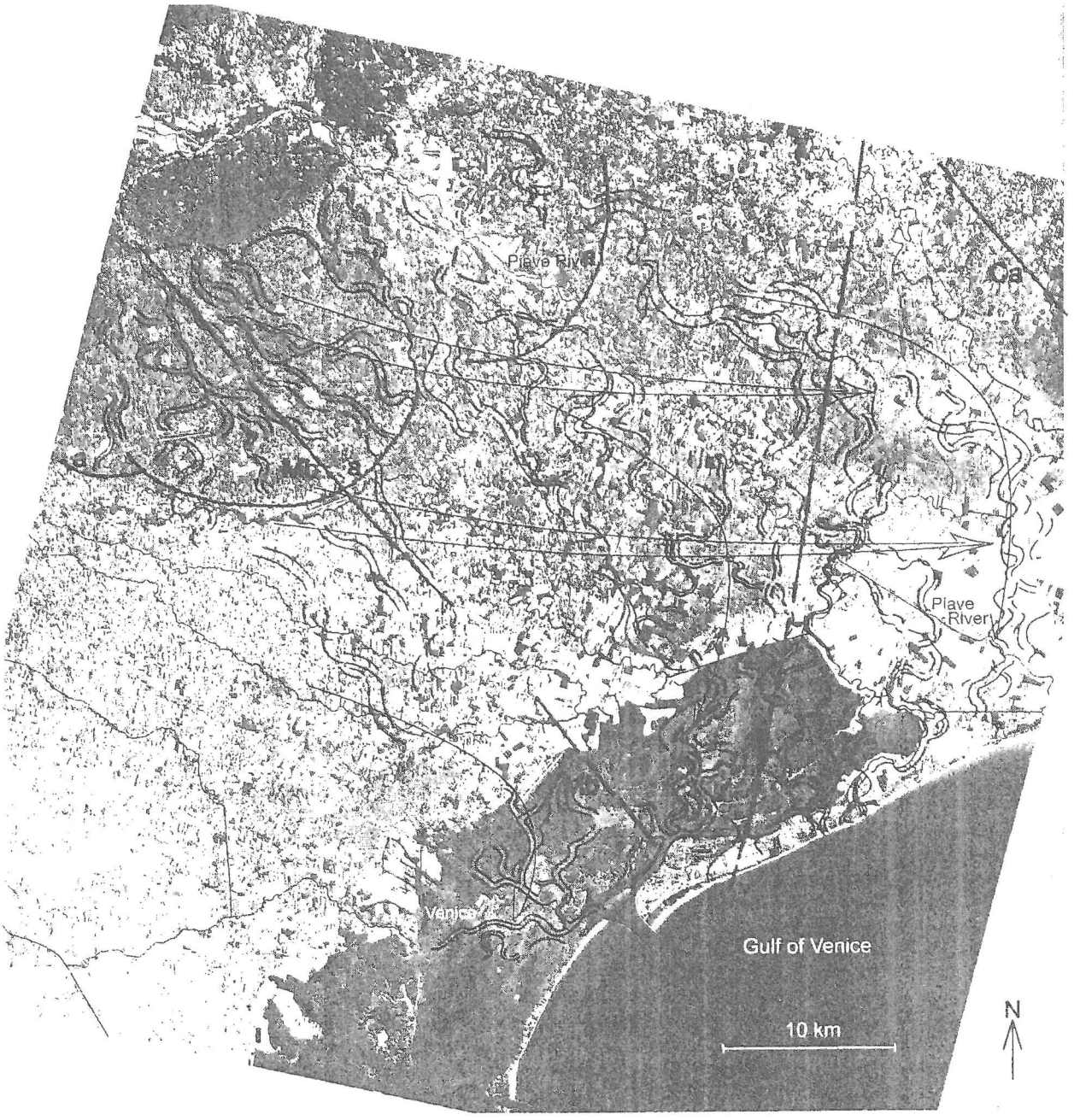

Figure 3 : **Venice lagoon basin and its hinterland.**
Ancient human settlement models. From a satellite SPOT1 image, Bd 2 and 3. The settlement typology are conditioned by the less natural hazards and the better resource availability. The example of the figure concerns the Roman land use model. During this historical period the Piave River was already active in the eastern region, having left behind to West a stable alluvial territory. Consequently the soils were utilized on the base of their agrarian productivity, as the different density of interpreted signs of the Roman hydraulic-agrarian nets shows.
In the lagoon basin, instead, the human settlements were localized on the old isles, putting in evidence a diffused but not random model.
The framework constitues an important parameter for a correct territorial planning with respect of the conservation of the Cultural Heritage of the region.

Figure 4 : **Venice lagoon basin.**
Ancient human settlement model: enlargement. From the former satellite SPOT1 interpretation (Figure 3). It is evident that the remains and sites are diffused and localized on ancient isles or salt-marshes, today most of them below the tidal level because of subsident phenomena. The model is characterized by a modular distance between the different sites and it represents a support to the archaeological researches.