WEB GIS APPLICATION TO AN INFORMATIC TERRITORIAL DATABASE FOR NATURAL RISK MITIGATION

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Introduction.
The technical note presented here introduces an innovative methodology dedicated to integrated management of territorial information. This methodology was developed within a convention between the Turin Section or CNR – IRPI and the Direction for Soil Defence of the Piedmont Region. Aim of the convention was to produce an exact definition of flood events, occurred along rivers and streams, which hit populated areas built in the valley bottoms of the Piedmontese territory.
In the same time, CNR – IRPI integrated its research activity with a the making of a census, followed by an analysis, of those phenomena which were linked both to the river/stream and the landslide activity; as a consequence, this interactive database became a first step towards an informative database including all the historical information stored in the Turin archive of CNR – IRPI.
Our study lead to a methodology made up of consequential processes aiming to a final product dedicated to land planning and management issues.

1. Methodological setting out of the new GIS extension.
The requirements to be met in the development of this new software were linked to the creation of a database that can be often and easily updated by a technical operator having in mind the achievement of a correct land planning.
What is new in this database is the information arrangement, their representation and the several ways by which you can use and manage them.
Keeping in mind land – planning requirements and the variety of issues contained in the historical documents, we developed a sample card which can give synthetic and selected technical information about the recorded events, phenomena and damages. Each card is linked to a specified event (time reference) occurred in a certain place (geographical reference).
Inside each card, information about geographical location, type of phenomena occurred (e.g.: floods or failures), defence operations (either in form of projects or actually accomplished) are also available. The so obtained retrospective frame provides us, within a satisfactory reliability degree, with information about the type of, the location and the extension of a phenomenon, together with a time interval between an event and another. Thank to such a method, we obtained a synthetic and detailed description of events which occurred one after another in the time. This made us able to get an immediate perception of an event in terms of geographical extension, effects on the hit land, and possible countermeasures.

2. Applications of the method.
The methodology her presented can be used for several purposes thanks to different data processing operations; more precisely we are now able to make considerations about:
- Number and frequency of recorded events;
- Localisation and characterisation of possible migrations in space and time of areas systematically hit by high density of failures;
- Effectiveness assessment of defence work/structures, based on their endurance to serious events;

- Geographical distribution of the recorded meteorological events; their analysis, their qualitative assessment and the determination of areas where they occur with the highest intensity and frequency.

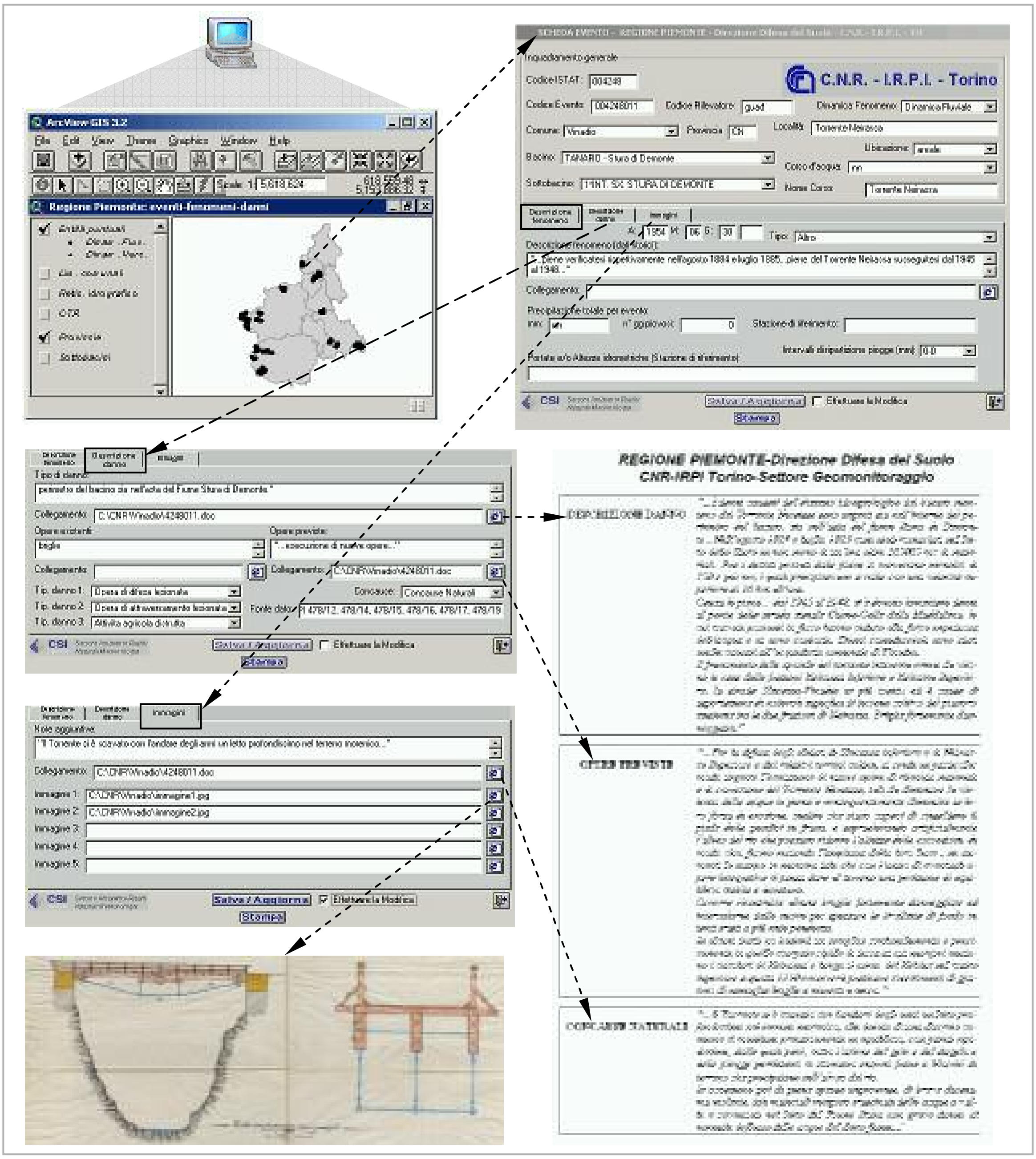

Figure 1: Sample scheme of the new GIS extension: over the topographic layer are placed point elements, to which single event-cards are linked. Some cards sections and the hyperlinks associated to them are shown too.

In order to examine closely the correlation existing between recorded events and the pluviometric frame of a related area, we chose the more significant recording stations. In such a way, we were able to correlate rainfalls intensities with the gomorphologic features, and the consequent instability phenomena, of an area.

3. Cataloguing of information inserted in the event – card.

The versatility of this interactive database lies on its several default and custom query actions that can be performed on the cataloguing of information inserted in the event – card. Each field of the card can be queried in a number of ways on the base of the requirement to be satisfied; for example, the cataloguing about the kind of structure involved may prove to be useful, you can get information about damaged bridges in a certain area or about every bridge damaged by a certain event or during a certain time lapse. The same query can be performed about works executed on a infrastructure or about the kind of damaged occurred to a road section or to a house. The information stored in the event – cards let you also perform comparison analyses as a contribution to the definition of possible risk scenarios.

4. Risk assessment.

Spatial and time analyses of stored information let the information system to perform a better individuation of several different scenarios of hazard and risk. The link between hazard and risk is a function of the level of damage caused by certain natural events interfering with man – made structures; the social and economic value of them determines the level of risk.

Applying these schemes to phenomena related to the action of rivers, streams and landslides, may sometimes raise some difficulties. Indeed those phenomena show extremely variable features and often interact one with another, leading to very complex processes with parameters that often cannot be easily determined. An analysis of the evolution in time and space of the whole amount of the acting phenomena and of their effects, provided certain priming events, may be performed by means of the integrated information system described here.

A land mapping of the regional territory, made taking into account the different instability phenomena, let us spot those areas which interfere most with natural events; this feature was assessed on the base of several factors derived by information taken from historical data. More precisely the considered parameters are the following:

- Type of event (fluvial dynamics, slope dynamics);
- Type of infrastructure involved (house, road, factory);
- Presence and effectiveness of defence structures;
- Type of damage;
- Frequency of the damaging event.

However, in order to be able to assess the total risk, it is necessary to know the "elements subject to risk" which are population, properties and economical activities that are present in a certain area. Therefore, in case of a house, we took into account the presence of people inside the structure, while in case of a road, we considered the vehicles flux, that is the related traffic intensity.

On the base of these factors, we can imagine a continuously updatable risk scenario concerning the studied sites.

Remark: The software was realised by CSI-Piemonte, Settore Ambiente, Rischi Naturali e Meteorologia.

5. References.

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