

THE GEOGRAPHICAL INFORMATION SYSTEM (WEBGIS) FOR THE MANAGEMENT OF EMERGENCIES IN CALABRIA, ITALY

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ABSTRACT:

The Calabria Region Civil Protection Sector has developed and performed a Geographical Information System. It is an extremely developed cartographic internet structure, integrated with WebGIS technologies, that offers all the users-actors interested, quick and essential answers about all the operative and informative needs. The System can be used by the technical staff, the common citizen and by all the bodies wanting information about the activities of the territorial structures, the normative provisions, the exercises, the right behaviour to be kept in case of a disaster.

It offers, also, detailed thematic maps, maps of emergencies, information about studies and connected risks of a territory. The GIS results particularly helpful in the prevention and management of risks as it delineates regional territories risks maps based on the characteristics of single zones' danger, exposition and vulnerability; it defines too the scenarios of reference according to the risk typology selected.

The System lets treat all the types of information traditionally contained in a thematic map and makes possible to integrate the contained information with many other data, so giving the possibility to prefigure scenarios and simulate events. It defines the procedures, the competences, the operative modalities, the duties and the tasks at municipal, Prefect, Provincial and Regional level. The system is always up-to-date. It is an essential instrument in support of Decisions (DSS) and helps the whole Calabria Civil Protection Organization support at best, first aid, prevention and planning emergencies, so protecting the human health and the natural and cultural patrimony.

RÉSUMÉ:

Le Département de Protection Civile de la Région de Calabre a développé et réalisé un système d'information du territoire, développé avec technologie WebGIS, qui aide à supporter efficacement la prévention et la planification des émergences. Il s'agit d'un portail unitaire qui est en mesure de mettre à disposition de tous les usagers/acteurs concernés, avec de critères de sécurité particuliers, un moyen efficace capable de répondre rapidement et essentiellement aux exigences opérationnelles et informatives de protection civile. Ce système peut être employé tant par le personnel technique, que par le citoyen commun, ou encore par toutes les Organisations qui nécessitent d'informations sur les activités des structures du territoire, les mesures législatives, les exercices, les comportements à adopter en cas de catastrophe. En outre, il fournit des cartes thématiques du territoire et permet de simuler des scénarios de risque pour l'analyse de données et informations nécessaires pour la prise de décisions. Il se révèle particulièrement précieux dans la prévention et dans la gestion des émergences.

Le Système permet le traitement de tous les types d'informations contenues traditionnellement dans une carte thématique et de l'intégrer avec d'autres types de données, tout en permettant le monitoring rapide du territoire et la mise en œuvre de stratégies et décisions. Il détermine aussi tâches et compétences au niveau municipal, provincial et régional. La mise à jour du système est continue. C'est un moyen indispensable pour faire face, dans les meilleures conditions possibles, à la prévention, la planification et la gestion des émergences.

KURZFASSUNG:

Im Bereich Zivilschutz der Region Kalabrien wurde ein territoriales Informationssystem entworfen und verwirklicht. Es wurde mit WebGIS Technik entwickelt und ist unentbehrlich in der Vorbeugung bzw. Planung von Notfallzuständen. Es handelt sich um ein einheitliches Portal, das interessierten Kunden unter Berücksichtigung spezieller Sicherheitskriterien zur Verfügung steht, ein wirksames Instrument, das in der Lage ist, schnelle und wesentliche Antworten zu geben, die für den Betrieb und den informativen Anforderungen des Zivilschutzes von Bedeutung sind.

Das System kann sowohl vom technischen Personal, als auch vom einfachen Bürger sowie von allen Organisationen verwendet werden, die Informationen hinsichtlich der Aktivitäten der territorialen Strukturen, der Gesetzgebungsbestimmungen, der Durchführung und des Verhaltens im Notfall, benötigen. Im System sind Landkarten des Territoriums enthalten, die sich auf unterschiedliche Thematiken beziehen und es ermöglicht Risikosituationen zu simulieren und somit wichtige Daten und Informationen zu analysieren, die für eventuelle Entscheidungen bedeutend sein können.

Dieses System ist besonders wertvoll hinsichtlich der Vorbeugung bzw. der Organisation von Ausnahme- und Notfallsituationen. Es ermöglicht die Bearbeitung jeglicher Informationen, die traditionell in thematischen Landkarten enthalten sind und diese zu vervollständigen mit anderen Daten und garantiert so eine Überwachung des Territoriums und die Möglichkeit Strategien und Entscheidungen zu realisieren. Es definiert Aufgaben und Kompetenzen auf kommunaler, provinzieller und regionaler Ebene. Das System wird immer aktualisiert und ist unentbehrlich in der Realisierung optimaler Voraussetzungen zur Vorbeugung, bzw. der Organisation und dem Management von Notfallsituationen.

INTRODUCTION

The Calabria history is characterized by antropic events and natural catastrophic phenomena. Everybody knows that earthquakes, floods and landslides are commonly present in territories where in past such catastrophic events happened.

In the latest years, for a very bad use of the territory and its resources, the destruction of the goods and the damages to population have increased, so making the entity of the risk and the first aid, in case of a disaster, variable parameters.

Considering that the emergencies are never equal, the Civil Protection operators have to be all the time ready to face the effects of the new event situation; so the necessity to know the physic-territorial peculiarities of the Region, to identify all the risk typologies and the most exposed sites, to find out the causes and to carry out systematic observations with the support of innovative technologies. All that permits a more rational use of the resources and a safe use of the territory through regional planning models aimed at protecting the human health and the natural and cultural patrimony.

1. METHODOLOGIES

The Civil Protection Regional Sector has developed and performed a GIS named SITgE (Geographical Information System for the Emergency Management), in support of Decisions (DSS), to be helpful to the whole Calabrian Civil Protection Organization, aiming at supporting at best emergencies prevention and planning.

The System is a modern architecture embracing the standards more diffused at present in the world of Informatics Technology (IT). The Desktop component is built on a Windows user interface that makes the GIS accessible to everybody. The WebGIS includes also standards for the Geographic Metadata (Federal Geographic Data Commission, FGDC), standards for the Web (extensible Markup Language, XML), standards for the web communication (TCP/IP) and a standard notation for the modelling of objects in the real world (Unified Modeling Language, UML) working together with the most diffused commercial database (DBMS) and supporting a great variety of formats among which those produced by Bodies such as the Open GIS Consortium (OGC) and the International Standardization Organization (ISO).

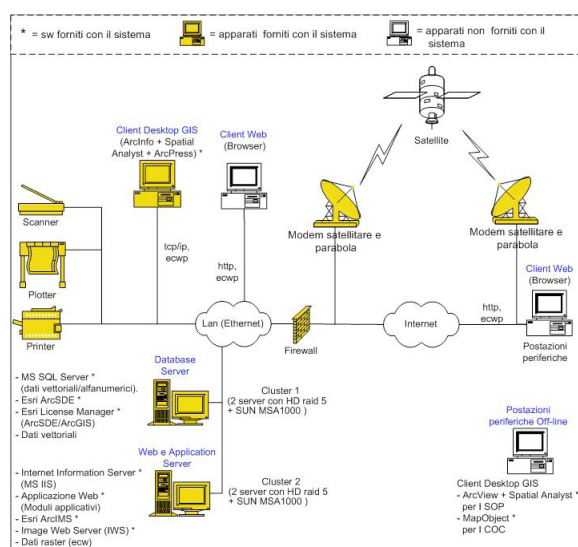


Figure 1. The System architecture

It includes formats by other providers such as the Oracle Spatial, Informix Spatial DataBlade and IBM Spatial Extender.

The personalization has been carried out using the Visual Basic for Application language, integrated with the software. The System, besides satisfying the final users' necessities giving them a just ready GIS application, has provided the most advanced users and the developers with some complete personalization possibilities by the use of drag and drop and menu-driven instruments. The SITgE aims at integrating with the OPEN-GIS standard. Such structure assures the compatibility with the other systems adopting OPEN-GIS standard, helping the exchange of cartographic data on different grounds, and giving the requesting users answers compatible with the standard.

The GIS phases have included:

- planning of the GIS, considering the environment of reference and the previous existing one;
- collection of the cartographic data of reference and data of the territory census particularly important for the Civil Protection;
- development of the System and involvement of the Sector staff in the different phases of the carrying out;
- system release and rollout;
- bank data population.

The mind structure of the GIS has based on the spatial relations among the different implemented informative strata and on the "Augustus" methodology that has the aim to manage the activities and the main provisions to be acted, at various levels of responsibility, as for the organization of the emergency first aid and the overcoming of the emergency itself.

Such methodology has operated a process of definition of the procedures, from the competences to the operative modalities: has defined duties and tasks at municipal, Prefect, Provincial, Regional level; has ordered instructions for the emergency planning.

In particular it has been designed a very simplified work method in finding and activating procedures of cooperation, functional to a successful civil protection result.



Figure 2. Portal introduction page. SITgE presentation

As for the main structure it has been chosen the Regional Unified Operative Hall (S.O.U.R.) and, second, the Prefect Operative Hall (14 Functions) depending on CCS (Aid Coordination Centre). Other centres are the COM (Mixed Operative Centre - 9 Functions) depending on the provincial structure, and the COC (Municipal Operative Centre).

The support Functions, at all levels, answer the emerging needs in every kind of emergency. Each function has a responsible with the duty to control the specific operativity and to updating the data.

The Ministers Council, to this purpose, has created an operative national handbook, (see OPCM August 28th, 2007, n. 3606) to provide the responsible Bodies with technical-operative instructions to be used in case of interface fire prevention and emergency.

1.1 The interface fire risk

The article one of the Council Ministers Presidency decree of August 28th 2007, n. 3606: “*Civil Protection urgent dispositions addressed to face the present emergency in Lazio, Campania, Puglia, Calabria and Sicily Regions in relation to disastrous events caused by the diffusion of fires and burning phenomena...*”, states that: “... *The Mayors of the interested above cited Regions have to arrange the Municipal emergency plans that have to take into consideration, first, the structures more exposed to interface fires in order to safeguard and assist the population such emergency plans, to be arranged by the Municipalities in a short time, need of the results of the activities contemplated by the same decree under the article 1 comma 8, that is of the perimetric measures and classification of the areas exposed to the risks caused by possible interface fires, and need also of the organization of the intervention models*”.

In order to obey to the dispositions of the decree, in October 2007 it was arranged, by the Head of Civil Protection National Department, an Operative Manual for the preparation of a municipal or inter-municipal Civil Protection plan. Such handbook gives Municipalities instructions so that they can determine risk scenarios with particular reference to the interface fires, illustrating also the principal aims to be adapted to the local realities and the intervention models with the activities necessary to an effective management of the emergency.

For the estimation of the risk, following the interface fires, it is necessary to define the riskiness of the interface area and the area external, to the interface perimeter, identifying the anthropic areas considered internal to the interface perimeter even on the base of the available orthophotos.

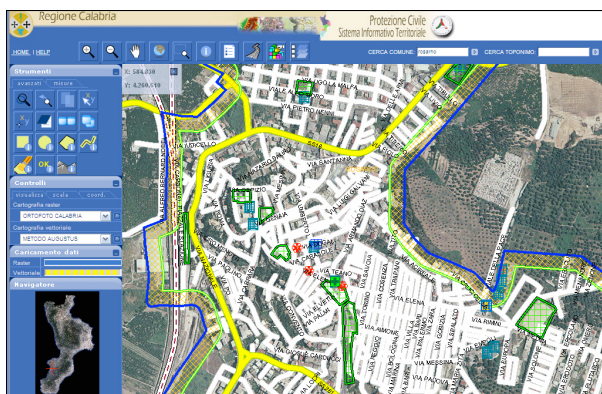


Figure 3. Visualisation and navigation mask inside the SITgE.
Municipal town planning inside the interface perimeter

Urban-rural interface are defined those zones, areas or strips where the interconnection between anthropic structures and natural areas is very narrow, that is those geographic places where the urban system and the rural one meet and interact, so as to be at an interface fire risk as they can come into contact rapidly with the diffusion of a fire originated by burning vegetation. Such fire can have an origin either nearby the settlement (due to the burning of vegetal remains or to the lighting of a fire during recreational activities in urban and/or periurban parks) or because of a wood fire interesting later the interface zones.

1.2 Objectives

The present work has dealt with the methodological contents and the first results of the multiple SITgE system functions. It has aimed at offering the Municipalities a technological operative support for carrying out the activities established in the Operative Manual by the Civil Protection Department as for the interface fire risk maps and the possibility for the Municipalities to set up informative cartographic archives of data-base about the municipal territory.

The implementation of the functions has been realized giving value to the base functionality already present in the SITgE and implementing only the specific functions, organized in a vertical system, on the applicative ground. In particular, the estimation of the interface fires risk has been made up, for each Calabrian Municipality, of a series of elaborations finalized to the definition of riskiness or vulnerability index or values, with reference to what established in the Operative Manual

1.3 The operative phases

The available SITgE instruments for the evaluation of the interface fires risk consist mainly of a series of elaborations, finalized to the estimation of the above mentioned index or riskiness and vulnerability values. Riskiness values are given to the parts of the territory thought potentially interested in disastrous events and external to the interface strip's perimeter, while vulnerability values or index are referred to the risk exposed elements present in the strip.

Such elaborations are carried out on the data base (Maps, cartographic layer, alphanumeric fields/ data associated with the informative layers present in the SITgE and managed through *Augustus* form) put in or up-to-date through the *Augustus* form, present in the System and modified or created to this purpose.

In particular two new “*Augustus*” forms have been implemented: the first, named “*inhabited areas*” permits to delimit the zones where new urban settlements are present; the second, named “*vegetation area census*” permits to build the informative layer of the vegetation. Both are the basic elements for the risk valuation procedure.

The riskiness estimation comes through an automatic procedure that carries out, in succession, a series of operations, computing values whose sum gives the riskiness value. The starting point is the determination of the external perimetric strip, through a buffer of 200 meters on the elements of the informative layer “*inhabited area*” present in the system. Soon later the procedure carries out a superimposition of the above cited strip with the informative layer “*vegetation areas*”, considering the vegetation and the contact type density values according to the instructions of the Operative Manual. As for the estimation, it is carried out the superimposition of the external perimetric strip with the DEM (Digital Elevation Model), finding, for each area, a value concerning the slope classification. The last operation related to the riskiness value estimation, consists in superimposing the perimetric, external strip with the informative historical fires layer present in the System.

Classifying the value of the distance between the historical fires and such strip, it is obtained the last index to be considered in the sum forming the riskiness value. The evaluation of the vulnerability is equally carried out by an automatic procedure determining the interface strip, made up of an internal buffer of 50 meters of the layer “*inhabited areas*” and puts in evidence the structures exposed inside the strip, that is the sum of elements considered in the municipal “*Augustus*” forms included in the SITgE System census and referring to the municipality.

The estimation of vulnerability is obtained through the sum of the values of sensitivity of each structure- included in the census inside the interface strip.

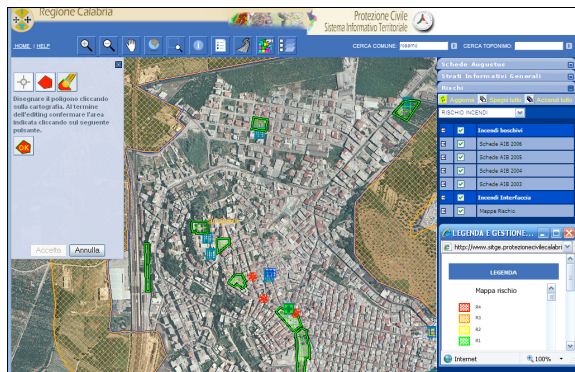


Figure 4. SITgE editing and implementation mask. There are visible the structures exposed and the zones at a risk.

The risk map is produced crossing in the right way the determined riskiness and vulnerability data, for each part of the interested territory. Once estimated the areas' riskiness and vulnerability values by the system, it is possible to display and later on to print, the interface fires risk map, thematising the parts of the interested territory on the base of the resulting values (R1, R2, R3 and R4). The system, thanks to automatic procedures, is so ready to determine, for each Municipality the riskiness and vulnerability index, together with the arrangement of thematic maps synthesizing the interface fire risk.

2. OUTCOMES

The GIS is a unified structure integrated with WebGIS technologies, offering, all the users-actors interested, a simple, sure and effective instrument able to give all the operative and informative needs quick and essential answers. The System can be used by the regional technical staff, by the common citizen and by all the bodies wanting information about the activities of the territorial structures, the normative provisions, the exercises, the right behaviour to be kept in case of a disaster. It can also offer detailed thematic maps, maps informative of the territory, documents of interest, data for the planning and the management of emergencies, information about studies and connected risks of a territory. The system is always up-to-date thanks to the possibility to do this on-line by the responsible of each function. Every responsible, indeed, (suppose the volunteer function responsible or others), can connect to the system, via web, updating and modifying the data with reference, for instance, to new volunteer' s names or a changed situation, or new recovery sites or areas that are clearly mapped. All the modifications are carefully checked in order to have up-to-date data when necessary.

The Civil Protection technicians can simulate risk scenarios by which to analyze data and essential information in support of operative decisions for the prevention of the risk.

The instrument results particularly effective in the prevention and management of risks, as it:

- delineates risk maps of the regional territories basing on the characteristics of danger, exposition and vulnerability of each zone;
- establishes the scenarios of reference according to the risk typology selected.

The cooperation of all the Structures and Administrations involved gives value to the decisional process of intervention.

The building of a Geographical System is strictly associated to the knowledge of the territory (physical structure, works, web systems, population and so on) and to the possibility to manage the problems associated to the calamitous event. So the importance and necessity of the GIS technology that gives the possibility to interact with the various steps of a territorial analysis and management (prevention, planning and emergency). The technicians, starting from risk maps typologies, can produce other maps typologies that can be essential to the prevention and management of an emergency.

The Civil Protection Regional Calabria GIS, besides offering a point of access to the technical and operative information, contains a section devoted to the technical and normative document of an interest for those who work inside and outside the Civil Protection Calabria Regional Organization. Every user, basing on his login, functional role and territorial competences, can consult and download documents of an interest and integrate them with other documents of his own.

The system is an extremely developed cartographic internet structure. The whole System is planned so as to work even in the case it is impossible to connect Internet, thanks to a local *clone*, that is a copy, automatically up-to-date, of the System to be used also when it is impossible any link with the central System.

The methodology for singling out the areas exposed to interface fire risk has been carried out so that the results can be a support to the identification of the possible event scenarios both in the planning phase and in emergency management one.

In particular, the main objective of the present work has been that to guide the different people and Bodies involved in interface fires to arrange instruments and procedures in order to:

- enlarge to Municipalities the system of prevision, awareness and alert of the danger of the wood fires;
- identify and communicate the right moment and the conditions when a wood fire could change into an interface fire determining high and very high risk situations, to be faced as civil protection emergency;
- provide the people in charge of emergency activities with a clear and univocal picture about the evolution of the situations so as to start up an immediate and coordinated activation with the progressive involvement of all the civil protection components institutionally responsible and necessary to intervention.

3. CONCLUSIONS

The GIS technology is, for Calabria Region, an essential instrument for recording, storing, questioning, analyzing and visualizing information of geographic type. It let us deal with all the types of information traditionally contained in a thematic map and integrate with many other types of data so giving the possibility to prefigure scenarios and simulate events. That's in order to take decisions, to monitor the territory, to decide plans and actions.

In a risk situation, the use of a GIS helps the efficacy and the quickness of the intervention, optimizes the action priority, helps monitoring politics and strategies to face the territorial and environmental emergency, such as requested by "Augustus" method's organizational model adopted by the central national offices of Civil Protection, competent in civil protection management and plans.

The SITgE results, so, extremely effective in preventing and managing the interface fires risk, as it defines the maps present in the territory on the base of the riskiness, exposure and vulnerability characteristics of each zone; it moreover can establish the scenarios of reference in order to provide answers useful to face disastrous events through the cooperation and coordination of all the structures and administrative Bodies

involved, with benefits to be valued above all in the field of intervention decisional processes.

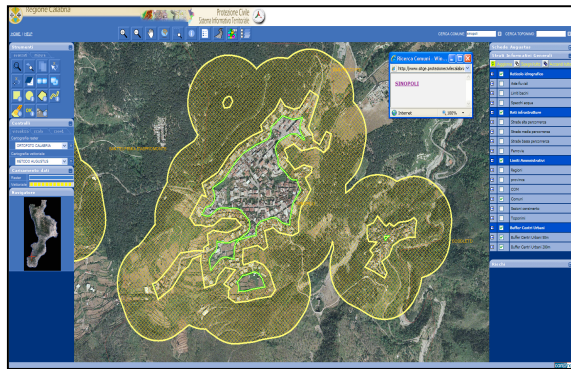


Figure 5. Buffers of urbanized areas

The use of a software instrument appears essential:

- in the phase of prevision and prevention when it is necessary to know the distribution of the risk signals and the outcomes of the technical inspections;
- in sending fast and homogeneous communication to people involved, especially in an alert time;
- in the management of emergencies when it is necessary to communicate in a quick way with operative centres and local structures dedicated to the direct management of the emergency;
- in the post-emergency management when there is the need to possess in a short time descriptive pictures of the damages produced on the territory so as to optimize interventions.

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