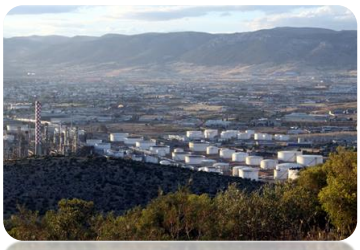
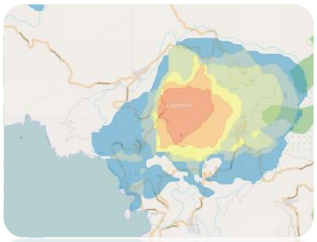




EVITA PROJECT

Wildfire Evacuation Trigger Buffers for Sensitive Areas

Project Funded by DG ECHO (2013-2014)

ECHO/SUB/2012/640929

Layman's Report – December 2014

Introduction

Computational tools capable of simulating the forest fire propagation phenomenon are tools offering significant support to competent authorities towards effective strategic and tactical decision-making. In the context of the EVITA project, a computational system has been developed which can simulate the fire front propagation according to various topographic and meteorological factors. Using this forest fire simulator, additional functionalities are provided, one is the delineation of the so-called Trigger Buffers. These are boundaries (buffers, zones) delineated to support population evacuation decisions. They have practical application at operational level, as they help national and regional Civil Protection (CP) authorities as well as industrial managers, hoteliers and local inhabitants know when they shall initiate an evacuation and how long they have to evacuate safely.

Case Study Areas

SEVESO

Description:

Athens concentrates about half of the population of Greece. A lot of refineries, chemical industries and warehouses are located in the broader region of Athens and especially within the industrial zone of '**Thriassio Field**', about 15 km NW from the centre of the city.

Vulnerability:

Industrial installations at Thriassio Field handling certain quantities of hazardous materials (toxic, flammable, and explosive) can potentially cause major accidents if reached by a wildfire, endangering the health and safety of the population (workers and public), as well as the environment.

Hazard:

In case that such an accident actually happens, the workers and the population are at large exposed to extreme phenomena such as fallout, toxic clouds, thermal radiation, overpressure, and fragments. Therefore, prevention of such accidents and timely recommendation to evacuate are of paramount importance.

EVITA OVERVIEW

Controlled (organized) evacuation of the population should be examined as a prevention measure that needs to be carried out timely under certain conditions, while the disastrous event is in progress. These conditions can only be evaluated at local level. The experience with wildfires in Southern European countries has shown that when it comes to minimizing risk, it's better to be proactive than reactive. To that end, EVITA aims to help national and regional CP authorities as well as industrial managers, hoteliers and local inhabitants answer the following vital question in case they see a wildfire approaching:

"Should I initiate an evacuation and how long do I have to evacuate safely?"

Case Study Areas

Mallorca

Description:

The Balearic Islands are an archipelago of Spain in the western Mediterranean Sea, near the eastern coast of the Iberian Peninsula. The four largest islands are: Majorca, Minorca, Ibiza and Formentera. The archipelago forms an autonomous community and a province of Spain, with Palma as the capital city. With annual tourist arrivals of almost 12,000,000 visitors (80% international and 20% domestic), the Balearic Islands represent a suitable case study for the project. Additional characteristics are the small area (4,992 km^2) and rich natural biodiversity.



Sardinia

Description:

Sardinia is the second largest island in the Mediterranean Sea (after Sicily and before Cyprus) and an autonomous region of Italy. With an annual tourist arrivals almost 12,200,000 of visitors (67% of them domestic, 2% international and 31% European), Sardinia represents the second case study island: it is a large island (24,090 km^2), with natural biodiversity near the tourism areas. During the last years, and especially 2009 and 2011, Sardinia has suffered important fires, produced mainly during the tourist season, from May to October. For these reasons, Sardinia constitutes a well-motivated case study area for the EVITA project.



OBJECTIVES

- To promote a common understanding of trigger buffer zones as a novel means to assess the time until an active wildfire approaches a sensitive site.
- To improve operations relating to preparedness and response to wildfires approaching a Seveso II site.
- To implement a model to define the trigger buffer zones around any point of the case study areas.
- To develop a software tool which will allow the users to select a site on the case study areas and get the trigger buffer zones as an output.
- To identify, map and register the Seveso II installations on the industrial case study assessing the risk of a potential fire.
- To identify the tourist infrastructures on the case study Mediterranean islands (Balearic Islands and Sardinia).
- To promote the concept of wildfire evacuation trigger buffers focusing on a Seveso II site by means of two exercises (paper and field, conducted by the General Secretarial for Civil Protection of Greece) and a large information day in Athens during Greek EU Presidency in the first half of 2014.
- To disseminate the project concept to interested beneficiaries and users via dedicated workshops in the three countries (Greece, Spain, Italy).

Key Concepts

Fire Simulator

Description:

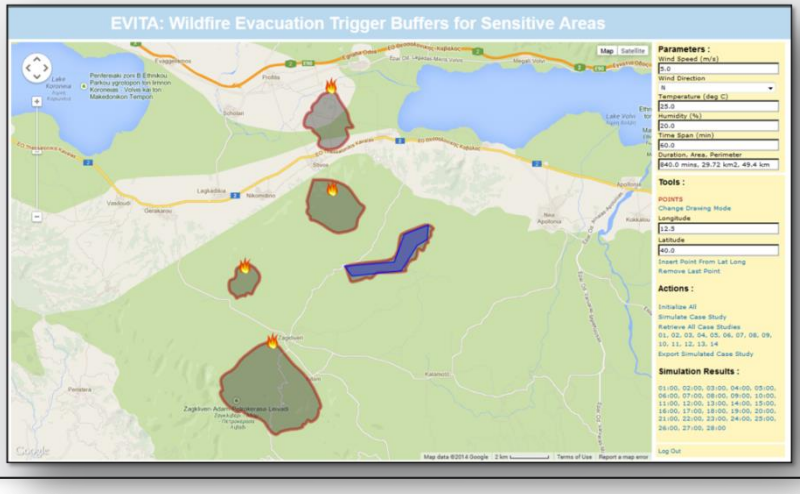
In the scope of EVITA project, a web-based computational system has been developed, that is capable of simulating the propagation of wildfire incidents, according to several topographic and meteorological factors. Based on this system, **Trigger Buffers** are identified for user-selected sensitive locations. Moreover, "**Landmark**" locations that if burnt, great risk is incurred for more than two neighboring sensitive locations are identified for wide geographic regions. The web application has been efficiently developed to provide wide geographical coverage. The functionalities provided by the computational system built in the frame of EVITA are based on a fire simulator backbone. This fire simulator is capable of calculating the spread rate of the fire front between a pair of locations and according to various topographic and meteorological factors. In the scope of EVITA, a variation of the neuro-fuzzy fire simulator is used.

Methodology:

The geographical data used as input for the fire simulator include satellite-derived European and global datasets:

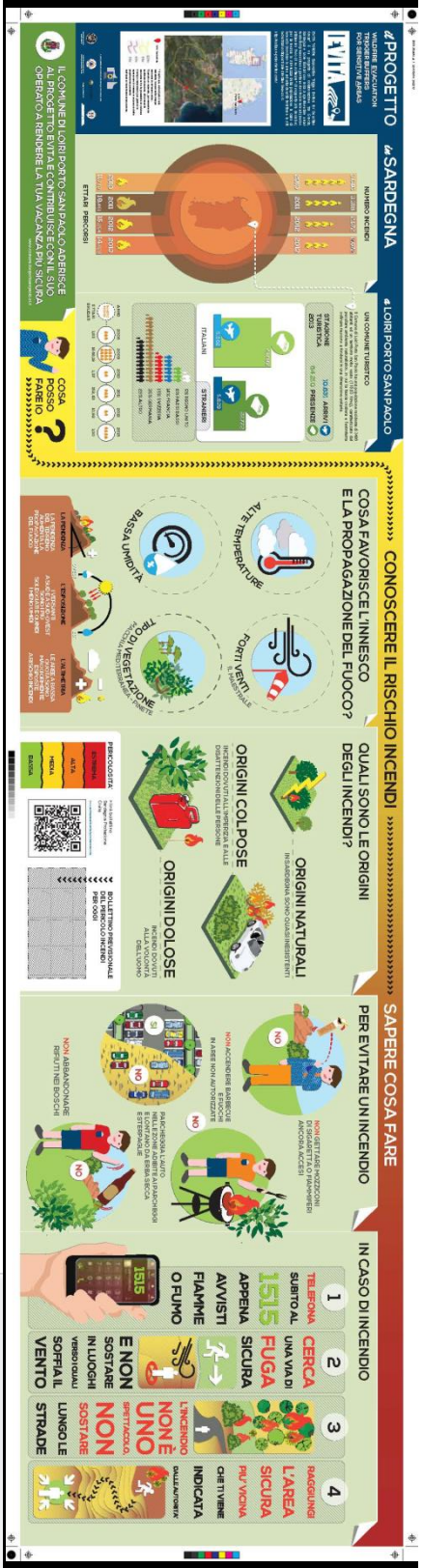
- Digital Terrain Model data were obtained from the Shuttle Radar Topography Mission (SRTM) (spatial resolution 90 m).
- European land cover was obtained from the pan-European satellite-based CORINE Land Cover (CLC) database (db), a widely used db of 44 land cover classes.

Central advantage of the computational system is its wide geographical coverage. The system is capable of simulating fire incidents for the whole southern part of Europe, while it can be easily extended to provide Pan-European and even global coverage.



DISSEMINATION

REGION OF SARDINIA



Trigger Buffers

Description:

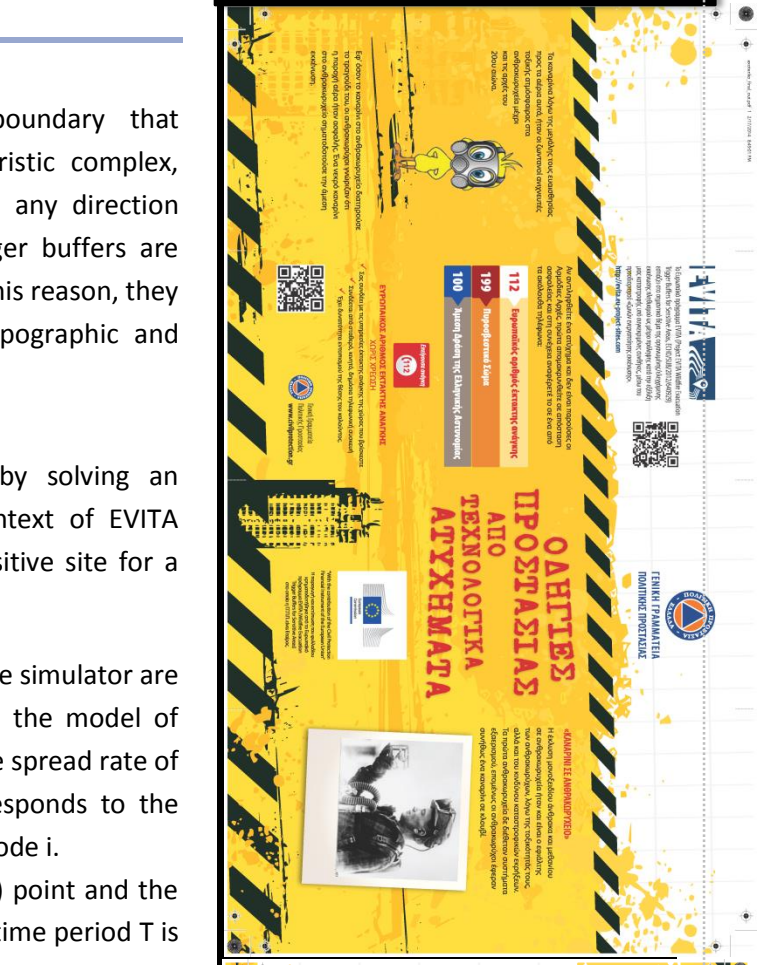
An evacuation trigger buffer is a pre-established boundary that circumscribes a fire-sensitive site (local community, touristic complex, industrial plant etc.) such that when a fire coming from any direction crosses the buffer, an evacuation is recommended. Trigger buffers are actually defined by the fire propagation phenomenon. For this reason, they have highly irregular shapes that depend on various topographic and meteorological factors.

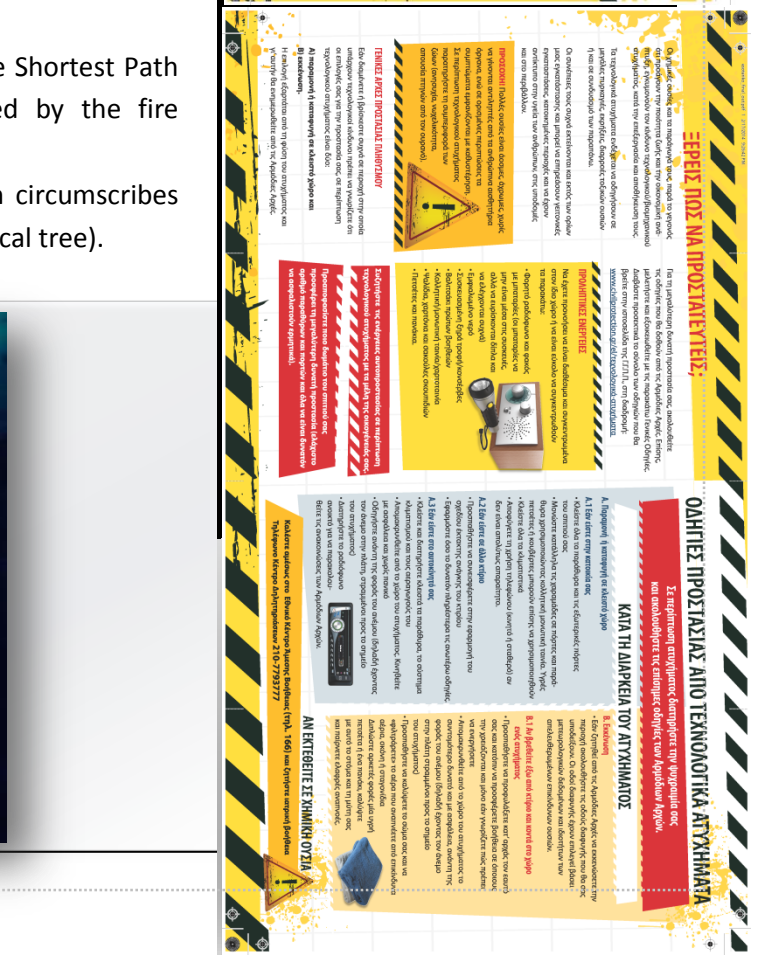
Methodology:

The propagation of the fire front can be simulated by solving an appropriately defined Shortest Path Problem. In the context of EVITA project, to identify the trigger buffer zones around a sensitive site for a time period T, the following methodology is applied:

1. In the first step, the fire spread rates computed by the fire simulator are inversed, since the trigger buffer zones are related to the model of inverse fire propagation. After this inversion step, the fire spread rate of an arc (i, j) starting from i and terminating at j corresponds to the necessary time for the fire to propagate from node j to node i.
2. The sensitive location is set as the fire starting (ignition) point and the corresponding Shortest Path Problem is solved until the time period T is completed.
3. The nodes that belong to the critical tree (buffer) of the Shortest Path Problem correspond to the geographic areas affected by the fire incident.
4. The Trigger Buffers are defined by the boundary which circumscribes every node affected by the fire front (included in the critical tree).

DISSEMINATION CIVIL PROTECTION OF GREECE





Landmarks

Description:

The level of threat posed by a forest fire incident can be quantified in terms of the sensitive locations that are prone to this fire incident. In this context lies the concept of Landmarks: geographic areas, which if affected by the forest fire, then a significant number of neighbouring sensitive locations should be considered to be in potential danger by the fire.

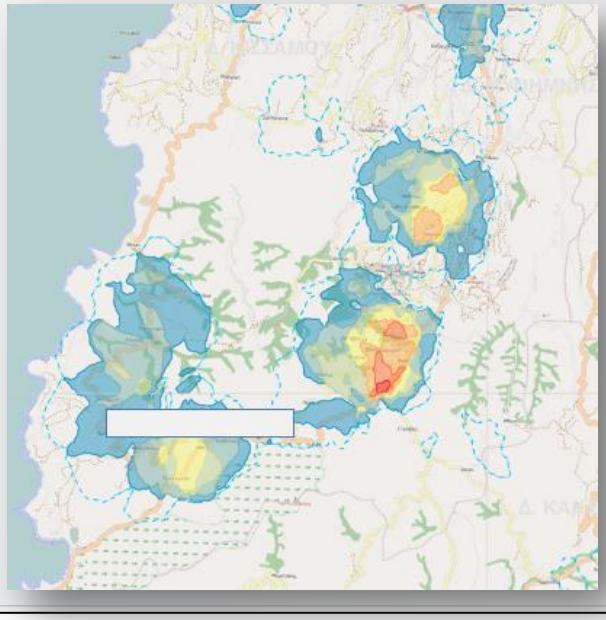
Obviously, to identify such Landmark locations several attributes must be fully quantified, such as: (i) the characteristics of the sensitive locations (type of sensitive locations), (ii) how undesirable it is to have a sensitive location affected by the fire incident, and (iii) the time required for the forest-fire to be moved from the candidate landmark position to the sensitive location.

Methodology:

The potential (examined) landmark location *i* is set as the fire ignition point. Then, the forest fire simulator is applied for a given time interval *T* corresponding to the progress of the fire incident. Let B_i denote the set of the areas affected by the fire incident started at point *i*. In addition, let r_j denote the "sensitivity" value of a geographic area $j \in B_i$. Roughly speaking, the r_j score is a metric to express how undesirable it is to have area *j* affected by the fire front. Then, a landmark score ls_i is calculated for the examined location. This score corresponds to the accumulated sensitivity value of all the areas affected by the fire front and is calculated as:

$$ls_i = \sum_{j \in B_i} r_j$$

Position *i* is considered a landmark point if the associated score ls_i exceeds a predetermined threshold value.



PARTNERSHIP

National Technical University of Athens (Coordinating Beneficiary)

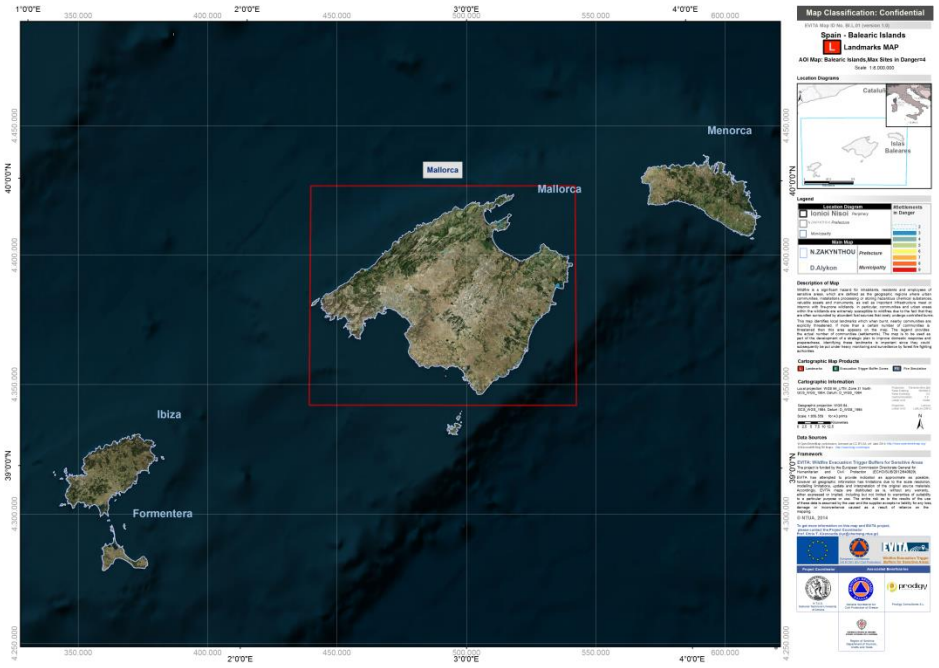
General Secretarial for Civil Protection of Greece (Associated Beneficiary AB1)

Prodigy Consultores S.L. (Associated Beneficiary AB2)

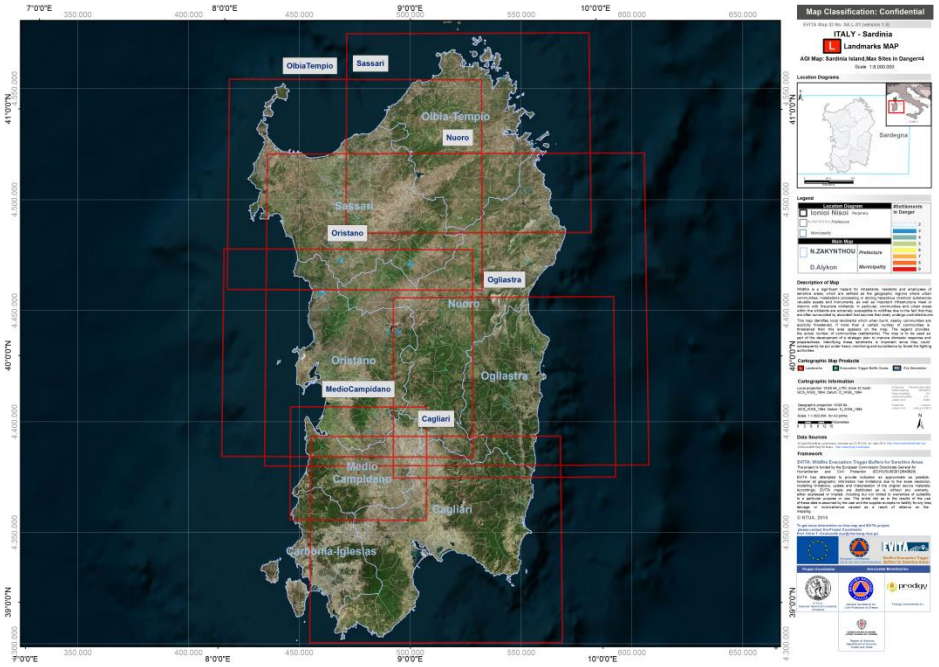
Region of Sardinia- Department of Tourism, Crafts and Trade (Associated Beneficiary AB3)

Results – Landmarks

Mallorca overview

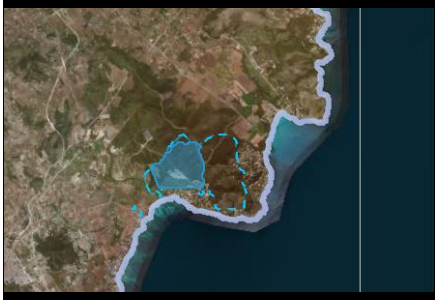


Sardinia overview



Landmarks Details

Mallorca - A



Mallorca - B

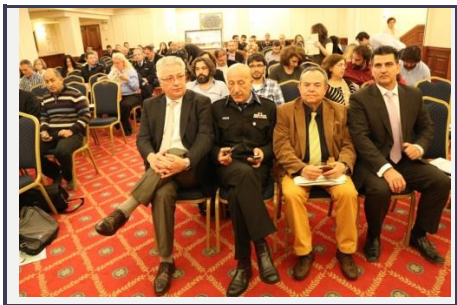
Sardinia - A

Sardinia - B

Sardinia - C

EVITA Events

Athens Workshop (April 27, 2014 – Athens, Greece)








EVITA Events

Sardinia Workshop (June 27, 2014 – Cagliari, Sardinia, Italy)





Mallorca Workshop (September 10, 2014 – Palma, Mallorca, Spain)




Exercises

EVITA – TTX - Athens, Greece, March 28, 2014

Basic TTX Features

The computational system developed in the frame of EVITA was tested and evaluated through a TTX that took place in Athens, Greece, on March 28, 2014.

TTX assumed a dual role: (i) participants from the authorities involved were able to familiarize themselves with the functionalities provided by the system, and (ii) participants were able to examine the value of the computational system as per the decision-making process during the response to a large-scale forest fire with the possibility of triggering a technological accident (a SEVESO II installation) and with regard to the management of the impacts at the wider area vulnerable to the fire incident considered. The TTX EVITA not only retained the key technology both with regard to the management and to the control of the exercise, as well as to the communication with the players. These innovations aimed to create an environment that enabled players to use technology in their favor, far from the traditional modus operandi, simulating real incident management and decision-making conditions.

The TTX introduced innovations in two very significant areas:

- The synergy of the academic community and its operational counterpart. In general, at an international level, the academic community does not participate in disaster management to the extent that it should. The TTX EVITA created a platform for real-time ad hoc cooperation.
- The management and the decision-making at an operational and tactical level, in a crucial event where a large-scale forest fire erupting in the Thriassio Field escalated, expanding to residential areas, crucial infrastructures and to a SEVESO II industrial installation, the "EVITA CHEMICALS SA".

At both the operational and the tactical level, players participated as representatives of the stakeholders in the management of critical incidents and in particular from the: Fire Corps, Police, Municipalities of Mandras - Eidyllias, Elefsis and Aspropyrgou and the District of West Attica. During the TTX the political/ strategic level was simulated by the EX-COM.

By the decision of the Secretary General for Civil Protection of Greece, the program EVITA was installed for further testing during the 2014 fire season at the Unified Operations Coordination Center. All the available feedback on the EVITA TTX helped prepare the participants/players for the full scale exercise that took place in Athens, on December 2014.

Fire Season 2014

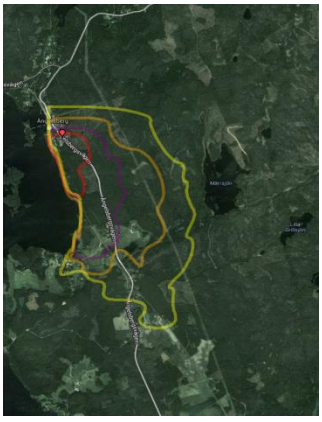
Overview

The EVITA model was first used “experimentally” during the 2013 fire season, when the Minister of Public Order & Citizen Protection requested the model to be applied in a series of large scale forest fires. During the 2014 fire season, the EVITA software was installed at the Unified Operations Coordination Center so as to be tested in real-time circumstances.

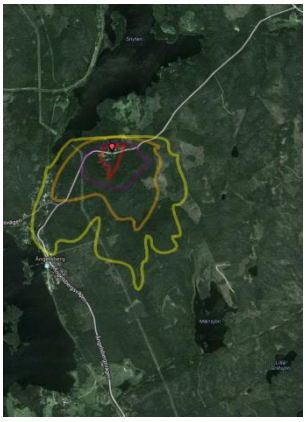
Sweden: An unexpected turn-out

On the 4th of August 2014, the Kingdom of **Sweden** and the Swedish National Civil Protection Authority requested assistance from the European Commission, activating the European Mechanism for Civil Protection to respond to major forest fires. Historically, it was the first time that a M-S from Northern Europe requested assistance in such a case. Initially, Sweden requested aerial fire-fighting means – a request that both Italy and France responded to. Spain was also prepared to provide aerial means. Greece, due to the ongoing high-risk fire season, could not make such an offer. However, Greece/GSCP in cooperation with the administration of the Directorate General of Humanitarian Aid & Civil Protection (DG ECHO), and upon their request, activated the EU EVITA software and offered a series of specialized maps to Sweden. Both the Commissioner Kristallina Georgieva and the Swedish Authorities publically expressed their gratitude to Greece.

Sweden: an unexpected case study



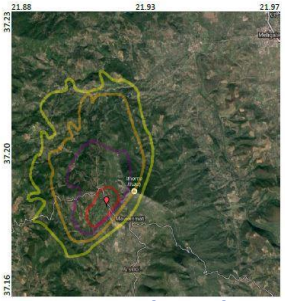
EVITA: Anglesberg



EVITA: Staback

Kalampaka, Greece

On the 25th of August 2014 Greece, by the order of the Minister of Public Order & Citizen Protection, a series of European tools were activated, including the European Civil Protection Mechanism and the EU EVITA project for managing the large scale forest fire in **Kalampaka**.



EVITA: Kalampaka

Full Scale Exercise

EVITA–FSE - Athens, Greece, December 1-2, 2014

FSE Features

The EU EVITA 2014 FSE exercise "travelled" beyond the borders. The FSE began on the 28th November 2014 via a number of informative e-mails to the participants and was escalated on the 1st and on the 2nd of December 2014. On the 1st of December, in one of the Conference Halls of the DIVANI CARAVEL Hotel, both players and observers were informed about the EVITA project through a series of presentations. One of the innovations introduced during that day of the full scale exercise was the intervention of significant officials in the field of Civil Protection in Europe via Skype, who gave critical information to the players with regard to the scenario, such as the Chief Fire Officer of the Hellenic Fire Corps, Lt General Vasilios PAPAGEORGIOU, the Head of Emergency Response (DG ECHO), Juha AUVINEN, the Director General of the National Swedish Authority for Civil Protection, Helena LINDBERG, the former President of the Working Party for Civil Protection (PROCIV) during the Italian Presidency, Luigi D'ANGELO.

On the 2nd of December, the Exercise Command Team "run" the FSE from the National Fire Academy while players from the operational level and the representatives of the Municipal and the Regional Civil Protection Authorities "played" from their posts – as would be the case in real-time emergencies. At the tactical level, the players operated from the fictitious SEVESO II installation "EVITA CHEMICALS S.A." at the Fire-Fighters School, at Vilia.

The FSE provided the participants with the opportunity to familiarize themselves with the EVITA software developed by the National Technical University of Athens and examine its potentials in the decision-making process whilst responding to large-scale disasters: a forest fire in the area of Thriassio Field that ultimately threatened a SEVESO II industrial installation.

Three facts remain notable:

- First, that for the first time in its history, the Arson Criminal Investigation Directorate (D.A.E.E.) of the Hellenic Fire Corps participated as "player".
- Second that both the staff as well as the trainees of the Fire-Fighters School at Vilia (department of the National Fire Academy) assumed the role of the "EVITA CHEMICALS S.A." employees and performed the evacuation of the fictitious installation, according to the scenario.
- Last, but not least, the FSE was closely observed by high ranking officials from the Civil Protection Authorities of Italy, Latvia, the Netherlands, Malta and Sweden as well as the bulk of all first-responder organizations and Public Services involved in emergency responses.

All the pertinent to the FSE material is uploaded at the official website of the program: http://evita.eu-project-sites.com

EVITA Web Site:
http://evita.eu-project-sites.com/

Contact email:
kyr@chemeng.ntua.gr

Acknowledgements

The authors acknowledge the financial support of the Civil Protection Financial Instrument of the European Community.

The sole responsibility of this publication lies with the authors and the Commission is not responsible for any use that may be made of the information herein.