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An approach to the management of terrorist attacks in urban areas using dynamic simulation

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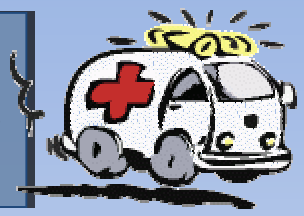
OBJECTIVES

In the last years, terrorist actions have increased. When an attack takes place, it is necessary to intervene as quickly as possible to reduce fatalities.



The knowledge of the "**time and space evolution**" of the event is an essential parameter for risk management.

1. Description of a **method to plan and manage the emergency** due incidental scenarios caused by terrorist actions.
2. Development of **a dynamic incidental scenario** on a georefenced map.
3. Construction, visualization and management of a dynamic event thought the **use of a GIS** (Geographic Information System) software.
4. Calculation of **the number of people involved** in the emergency

TERRORIST ACTIONS

Most terrorist attacks involve the public transport system.
The transport itself can be used as the terrorist weapon as in the attacks on the 11th September 2001 on the World Trade Center and the Pentagon.

Attacks on Public Transport Systems

Location of the attacks

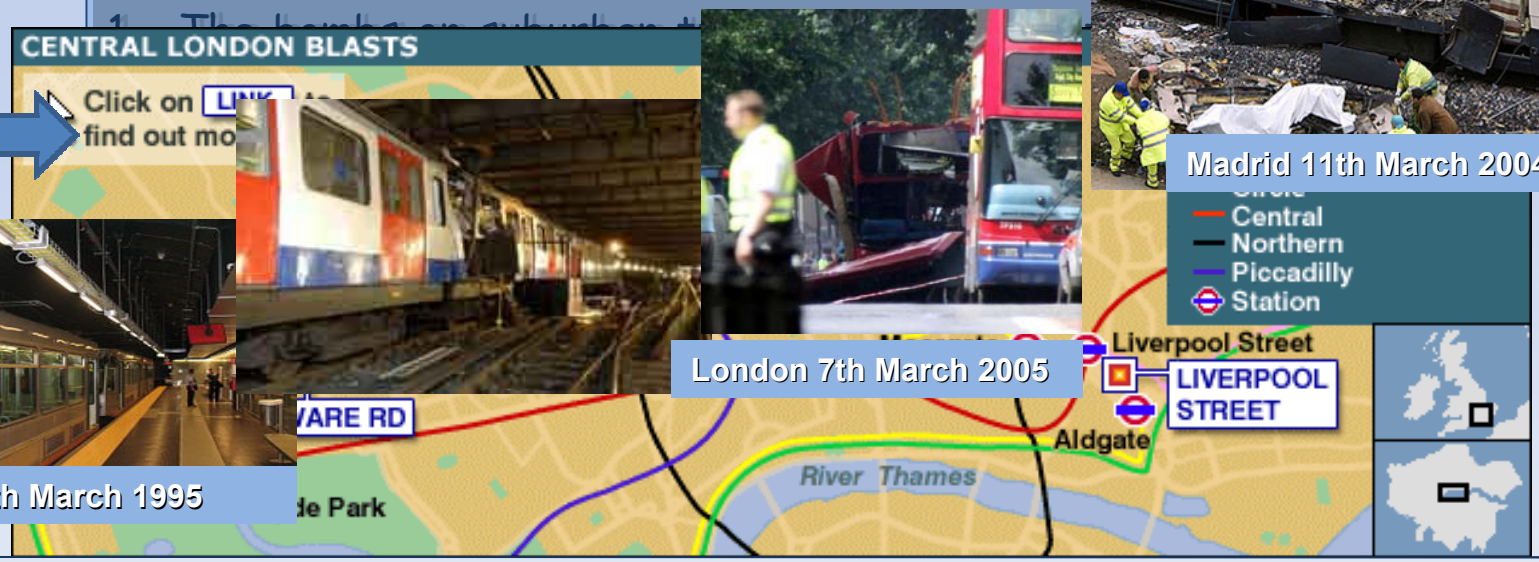
1. Explosions caused by devices left on vehicles;
2. Explosions caused by suicide attacks;
3. Releases of dangerous substances.

Examples

Madrid 11th March 2004

Tokyo 20th March 1995

London 7th March 2005



TERRORIST ACTIONS IN URBAN AREAS USING DANGEROUS GOODS

Chemical Attack in Iraq

BAGDAD (Iraq) – 22nd July 2005

In Iraq 22nd July 2005, a terrorist attack caused the explosion of a road-tanker transporting gasoline, while it was parked near the Shiite Mosque of Musayyib, south of Bagdad. At least 60 dead and 82 injured were reported.

FALLUJA (Iraq) – 17nd March 2007

A terrorist attack caused by a series of explosion of tree road-tanker transporting a toxic product, probably chlorine, with a total budget of 8 died and 350 hurts. The trucks exploded during Friday in three different locations in the Falluja area. Chlorine has been used in suicide car bombings in Anbar 5 times, during the past two months.

Chemical Attack in Europe

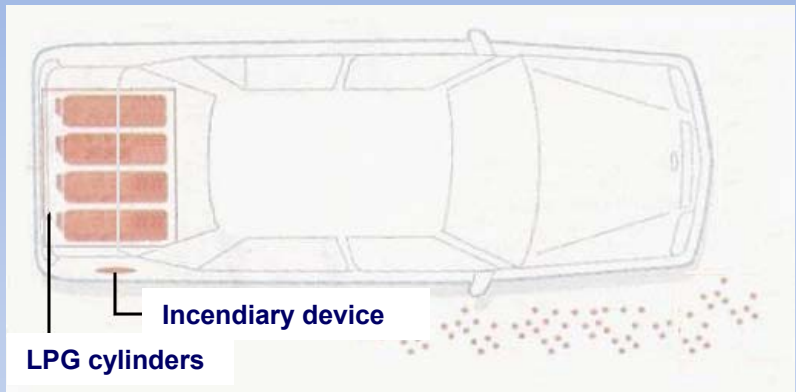
LONDON & GLASGOW (UK) - June 2007

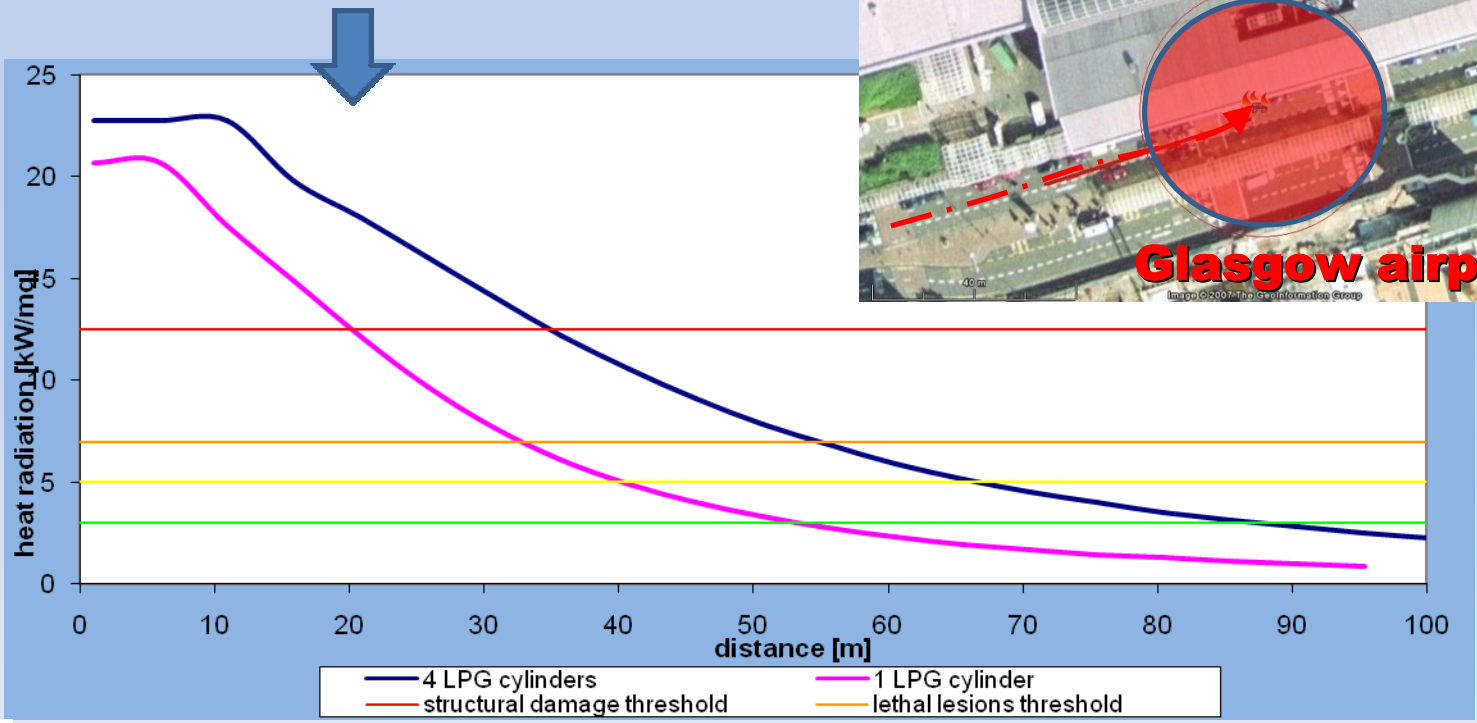
A jeep with 4 tankers of gas exploded consequently to the impact near the terminal of the airport of Glasgow

Two car bombing containing propane end gasoline has been placed in London downtown.

GREAT BRITAIN 2007

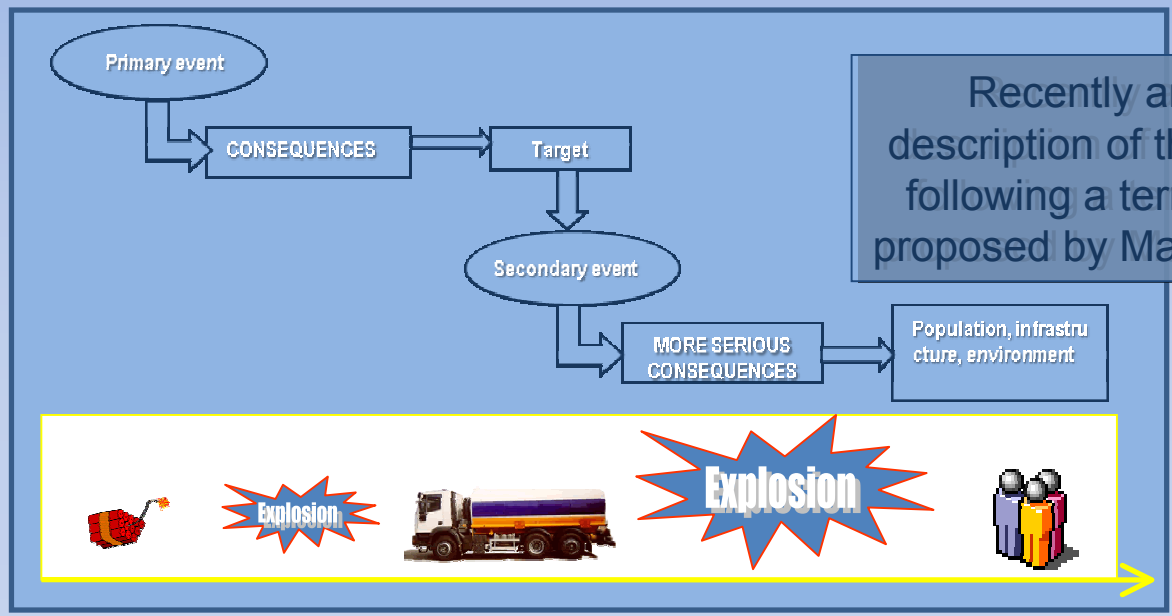
The car bomb in Glasgow airport attack





TERRORIST ACTIONS

The management of incidental scenarios due to terrorist actions



Recently an approach for the description of the sequence of events following a terrorist action has been proposed by Maschio & Milazzo.(2007)

Risk Assessment

1. Characterization of the area;
2. Qualitative study (identification of incidental scenarios);
3. Quantitative study of the incidental scenarios.

a. Frequency evaluation for the attack (primary event);
b. Frequency of propagation of the secondary event;
c. Consequences evaluation for the overall scenario.

Physical impact of incidental release scenarios are represented through a static **iso-consequence curves**. In many cases it is more effective to represent the event using an **animation**.

The knowledge of the time and space evolution of the accidental event **combined with a GIS** helps planning the response to the disaster.

The dynamic simulation approach

Construction of the dynamic simulation:

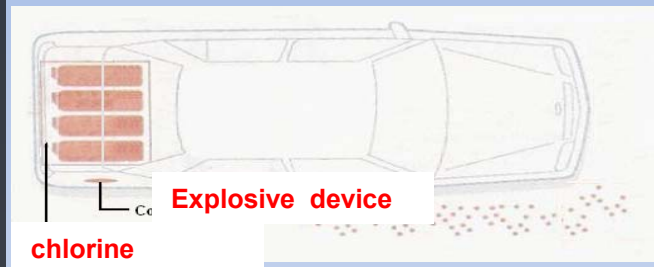
- Simulation of the space & time evolution release of the toxic substance;
- Construction of the dynamic scenario using a GIS tool.

CHLORINE RELEASE

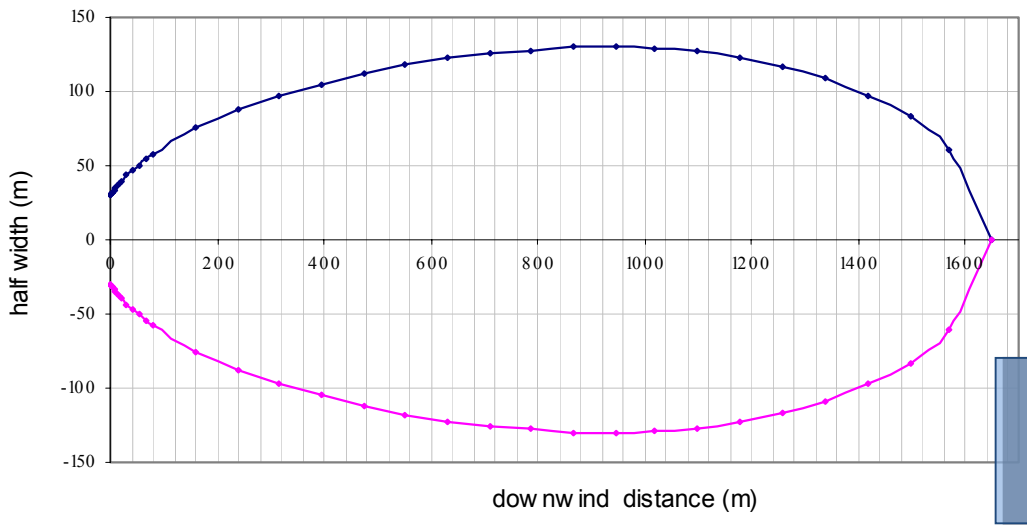
Simulation of the release

It has been assumed a terrorist attack realized through a "dirty" car-bomb consisting of four 50 l chlorine cylinders around an explosive device.

- The event causes the release of 250 kg of chlorine.
- The simulation of the cloud formation has been made using the "instantaneous heavy gas dispersion" model developed by the EPA (Environmental Protection Agency).



IDLH contour obtained using the Chems-Plus code



The damage zone has a length of ~ 1650 m and a maximum width of ~ 250 m.

THE GIS TOOL

A **GIS (Geographic Information System)** is an information system based on software technologies that allows the location, management and analysis of territorial events.

The GIS manages the information through a **database** and can be used also during an **emergency situation**.

The emergency management of accidental events requires:

- a **rapid response**: the GIS allows rapid data entry and visualization of the critical information related to the area of interest;
- the definition of the **impact zones**;
- the development and implementation of **action plans** for the protection of the population and the environment.

CLOUD EVOLUTION

The construction of the dynamic scenario using a GIS tool

Geographic location + Event = geoevent

Computation of the time evolution of the release using Chems Plus.

Transfer to geo-refenced system using colour coding concentrations.

Animation of the time evolution.

Geoprocessing

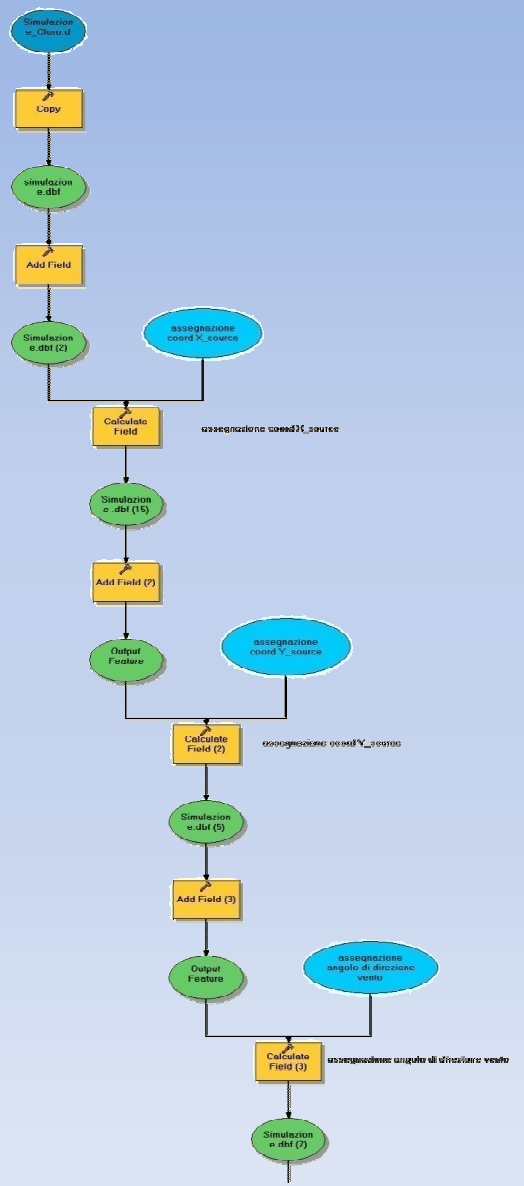
Assumptions

1. Circular shape for the time evolution of the cloud.
2. Absence of obstacles on the land.

THE GEOPROCESSING

The automatic geo-processing

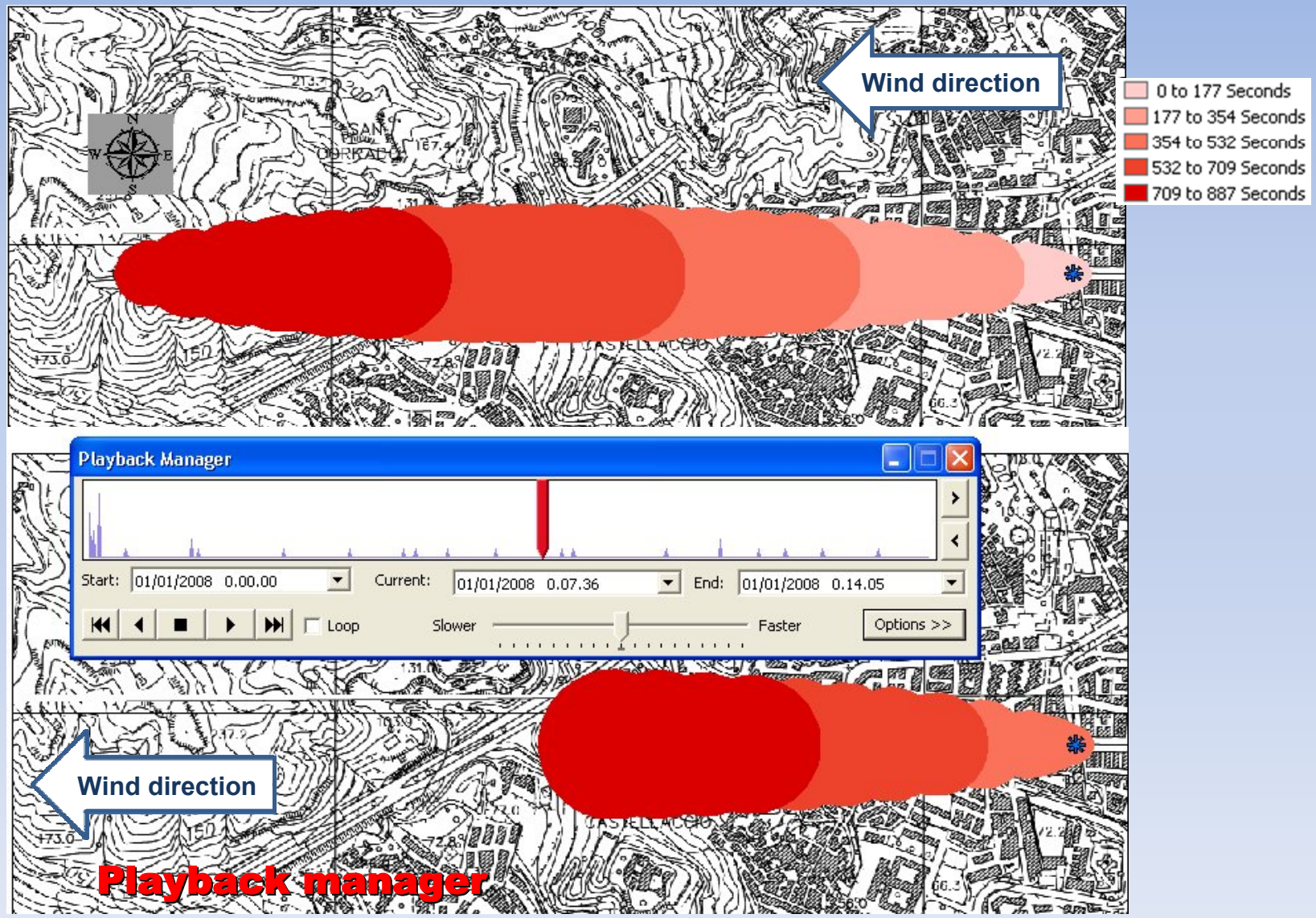
Sequence of geoprocessing operations for the construction of the **dynamic geoevent**.



The construction procedure can almost totally been performed in an automatic way

CLOUD EVOLUTION

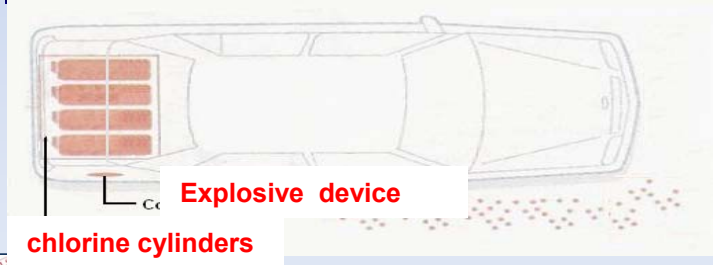
Visualization of the time evolution of clouds



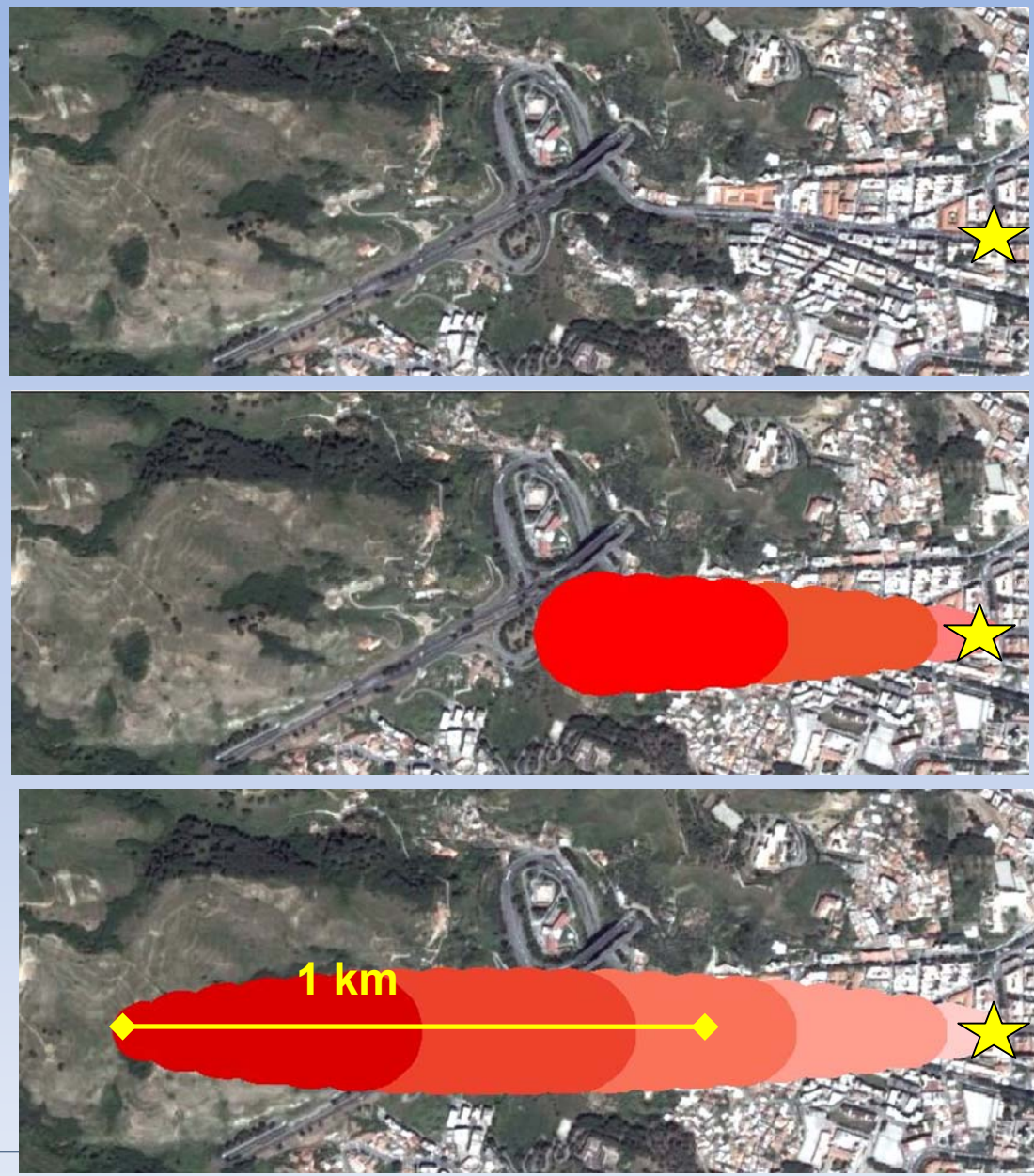
CASE STUDY

- The case study is a real but anonymous **densely populated urban area** where **a large number of road and rail tankers** transporting dangerous substances cross the downtown.
- **The critical point** represents the connection between the **main urban road** and the highway exit and the section of **railroad** crossing the downtown.

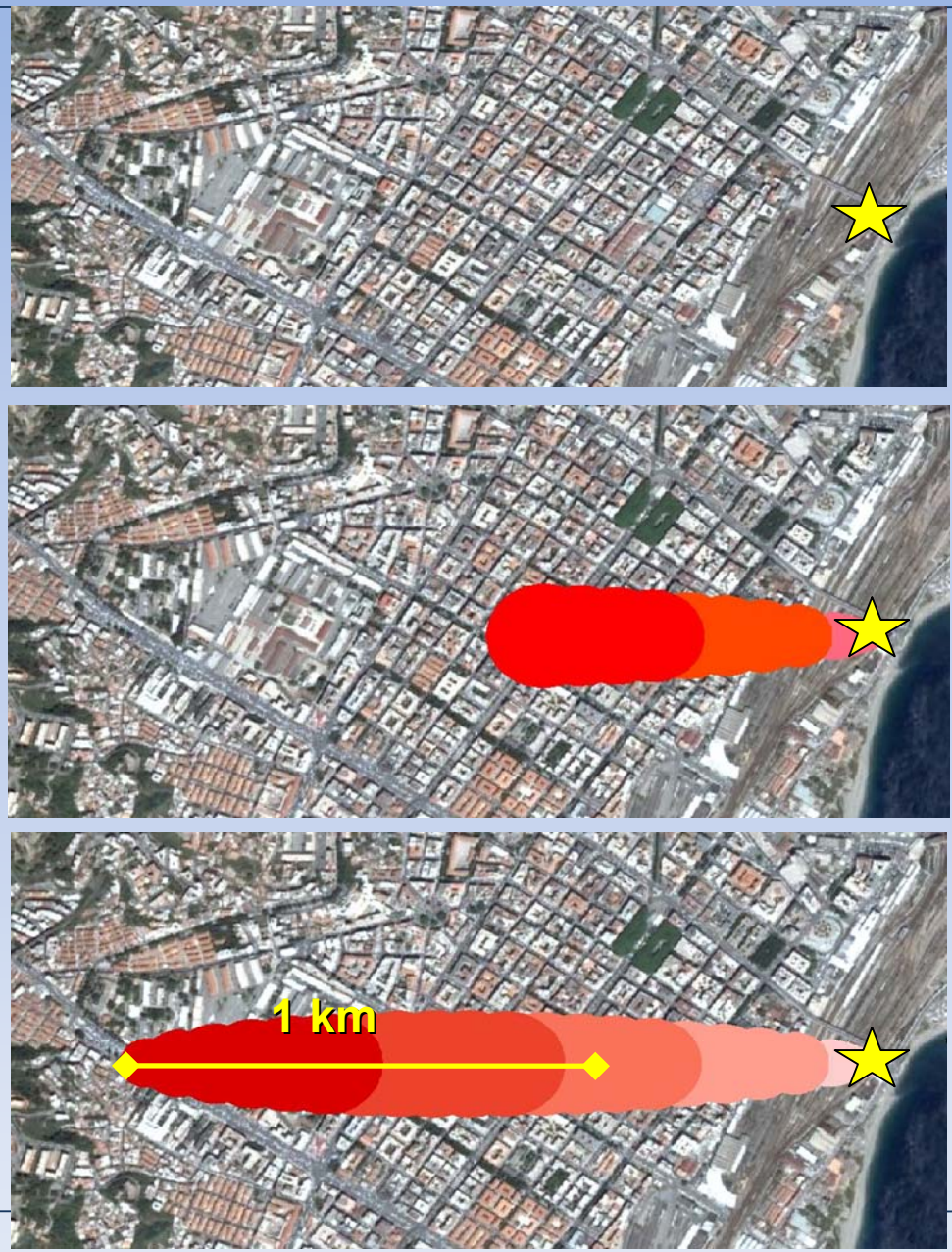
Identification of critical points



RESULTS POINT 1



RESULTS POINT 2



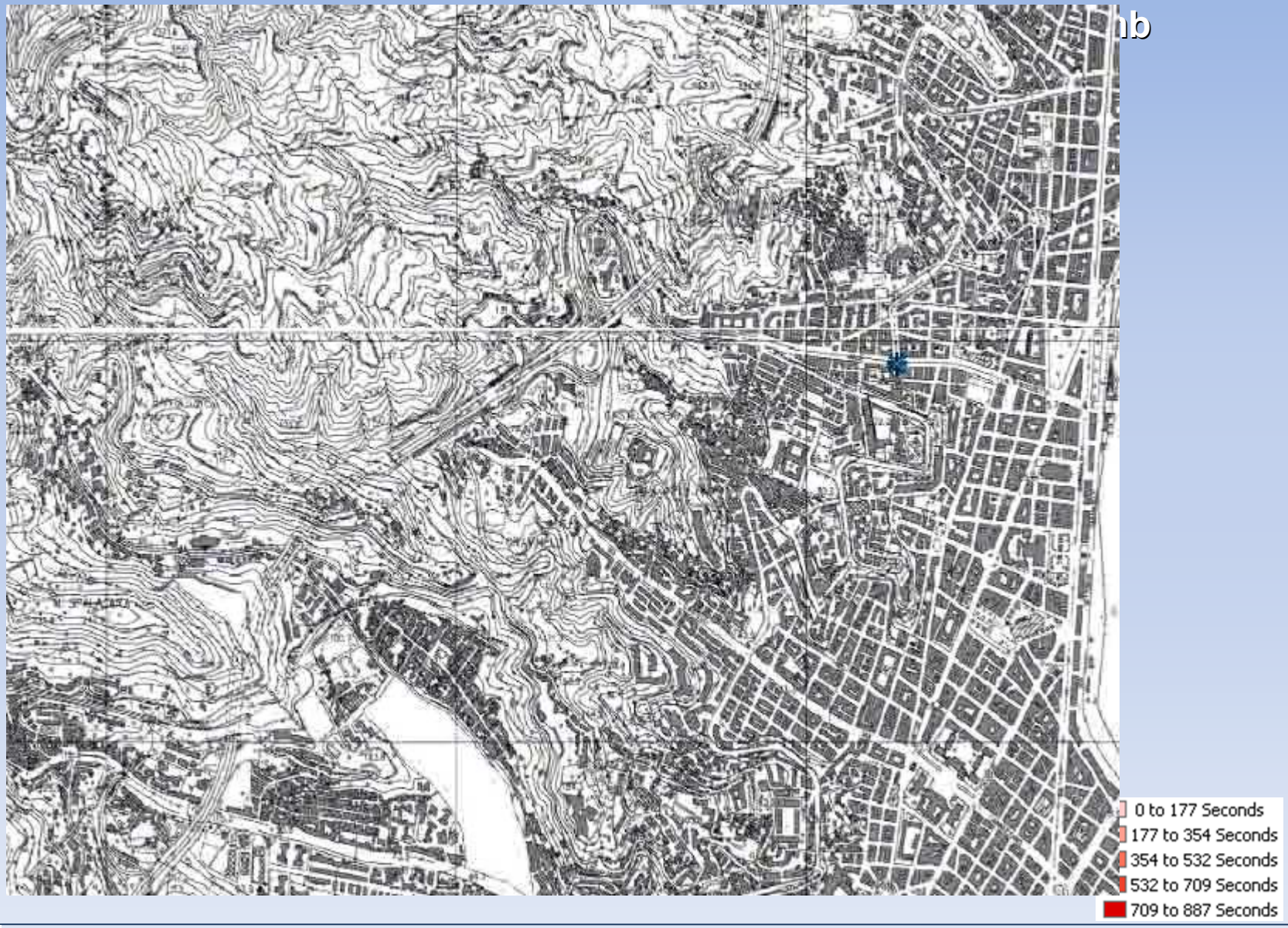
PEOPLE INVOLVED

Wind direction

0 to 177 Seconds
177 to 354 Seconds
354 to 532 Seconds
532 to 709 Seconds
709 to 887 Seconds

On the basis of the threshold value of the physical effects it is possible to calculate the number of vulnerable centres and people involved in a potential attack.
In this case study 22 vulnerable centres and 25179 people is involved in the emergency area.

ANIMATION


0 to 177 Seconds
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CONCLUSIONS

- ✓The aim of this work has been to give **the basis for the construction of dynamic scenarios**, so the approximation introduced can be considered acceptable.
- ✓The representation of the hypothetical accidental scenario through a **dynamic interface** shows the time variation of **the damage areas** caused by terrorist attacks for the examined area.
- ✓The effects map can constitute an important source of information for **emergency plans** and to apply **protection and/or mitigation measures** for the exposed population.
- ✓The **use of a GIS interface** allows the visualization of the interaction of the event with each geographical element.
- ✓**The implementation of this procedure** in order to take into account the real shape of time evolution of the cloud and the effect of the morphology of the area **is in progress .**

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