

# The Real-Time Spatial Delphi: fast convergence of experts' opinions on the territory

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# Outline

- 1. From Delphi to Real-Time Delphi**
- 2. From Delphi to Spatial Delphi**
- 3. Spatial Shang**
- 4. The Real-Time Spatial Delphi**
- 5. Application on Zoning of Prostitution**
- 6. Further developments**

# From Delphi to Real-Time Delphi

The **Delphi** method is a technique that uses opinions by a group of experts, generally in a decision-making context and/or a forecasting framework.

In 2006 a **Real-Time version** was developed by Gordon and Pease.

A **computerized questionnaire** without subsequent rounds and a greater efficiency in terms of execution time.

	Questions	Change Over Time	Media Influence	Personal Belief
1	Women are valued more for their physical appearance than their intellect or character.	<p>Suppose that a poll were taken in your country in the years shown. What percent of the people do you think would have agreed with the statement? (please enter numbers only; e.g. 50 for 50%)</p> <p>50 2061 (33.0) (155)</p> <p>60 2011 (56.0) (157)</p> <p>80 1961 (70.4) (155)</p>	<p>Today in your country how often do the media reflect this view?</p> <p><input type="radio"/> Always (20)</p> <p><input checked="" type="radio"/> Frequently (89)</p> <p><input type="radio"/> Sometimes (37)</p> <p><input type="radio"/> Seldom (5)</p> <p><input type="radio"/> Never (3)</p> <p>Your answer has been entered, and you may change it at any time.</p>	<p>Some stereotypes may be true. What about this one? Do you personally think this statement is true?</p> <p><input type="radio"/> Always (4)</p> <p><input type="radio"/> Frequently (45)</p> <p><input checked="" type="radio"/> Sometimes (53)</p> <p><input type="radio"/> Seldom (19)</p> <p><input type="radio"/> Never (23)</p> <p>Your answer has been entered, and you</p>

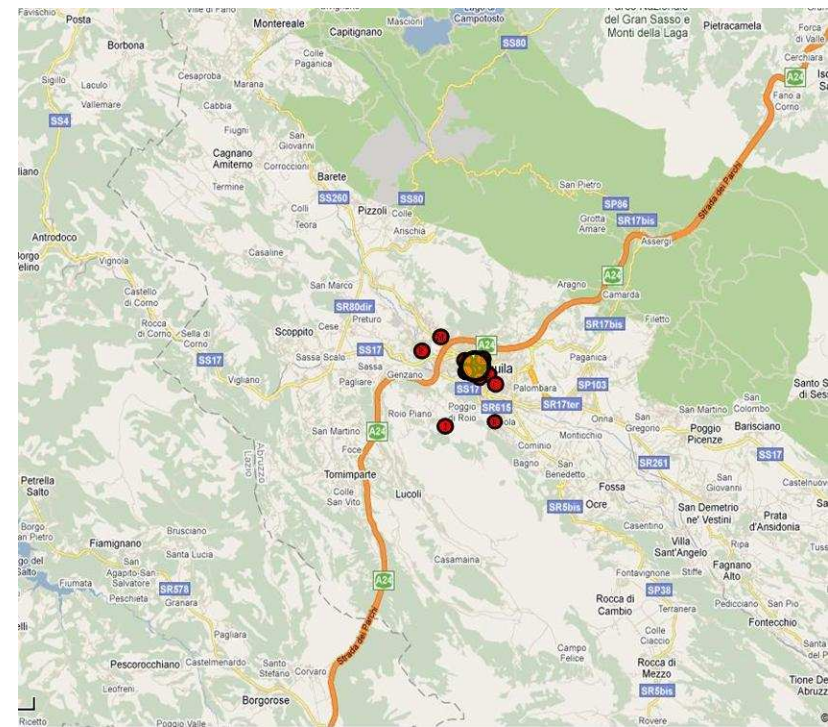
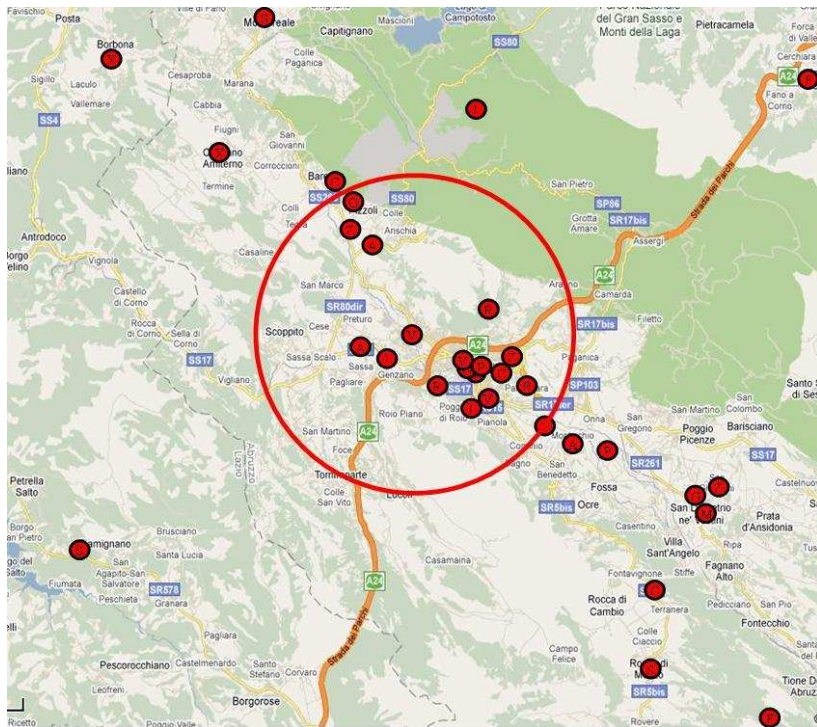
# From Delphi to Spatial Delphi

Often, the (Delphi) decision problem regards to find an **optimal area** on the territory.

- **The present:** choosing an optimal site to place goods or services or to act for a specific intervention;
- **The future:** predicting where a future event will be most likely to happen (catastrophic natural events, events resulting from scenario studies);
- **Underground:** the search for non-visible underground elements (archaeological surveys, mining, oilfields).

# The Spatial Delphi

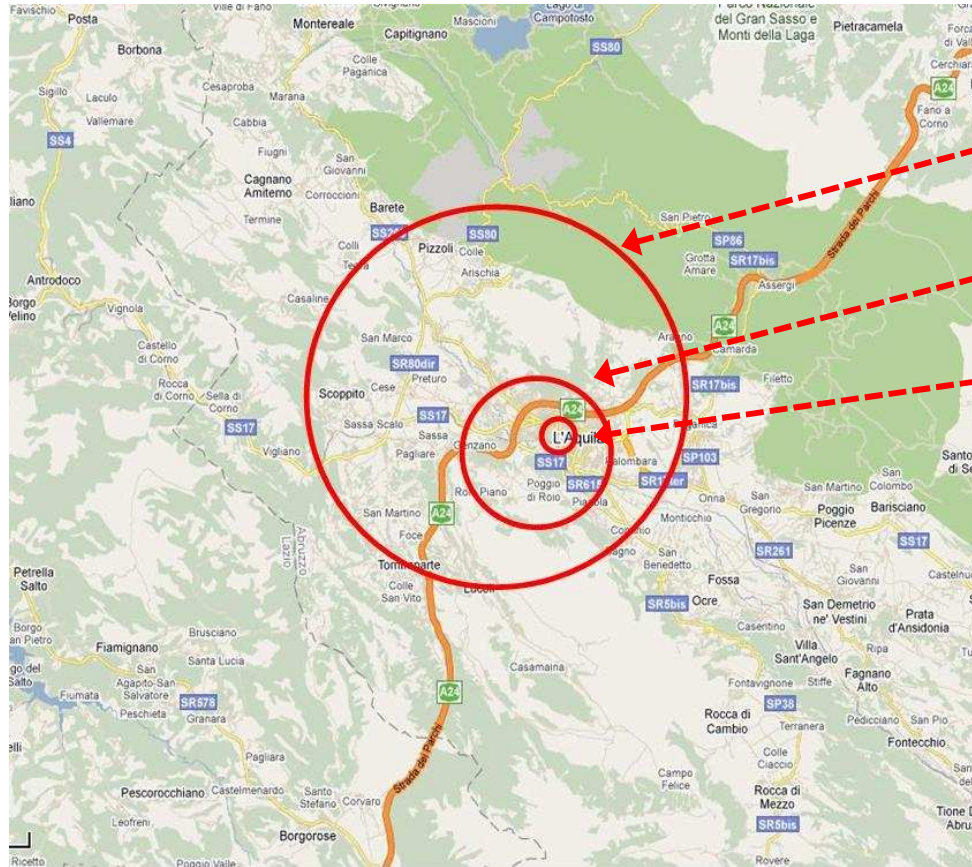
The **Spatial Delphi** (Di Zio S., Pacinelli A., 2011) has the aim to reach a consensus among a panel of experts in **finding an optimal location** in a limited geographic area.



The basis for the questionnaire is a map, on which each expert provides one or more **opinion-points**.



# The Spatial Delphi



Round 1

Round 2

Round 3

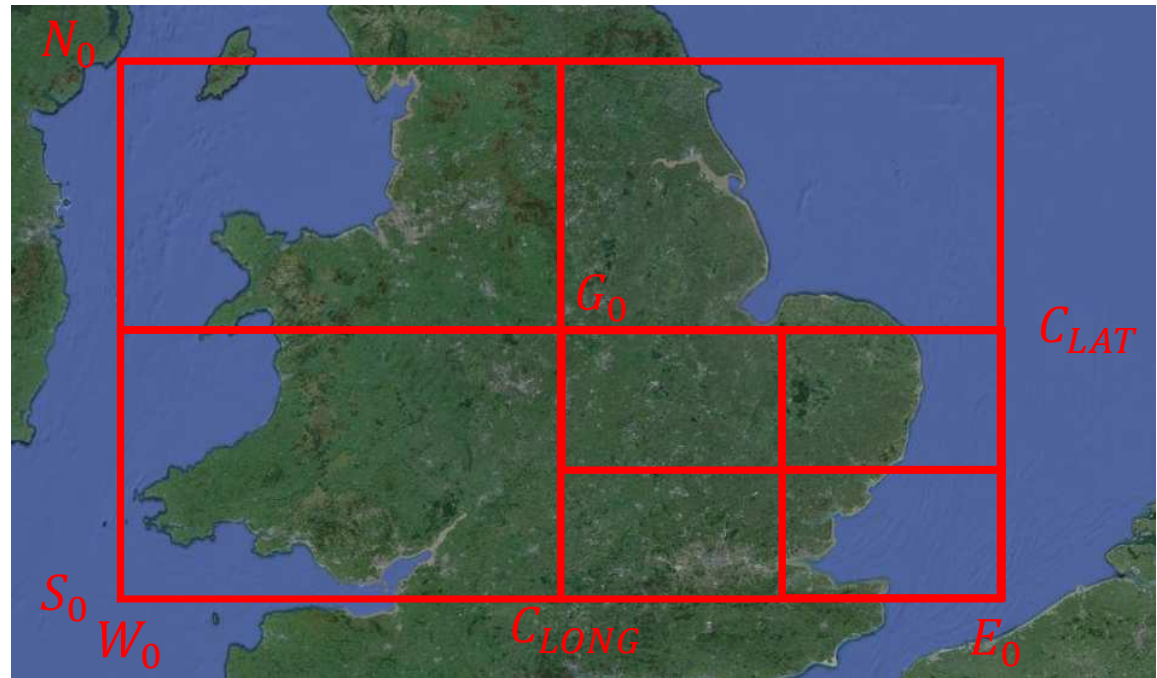
Each circle contains 50% of the Opinion-points

	$n$	$r_{best}$ (Km)	$A_{best}$ (Km <sup>2</sup> )	% of total area	$FD$
<b>Round 1</b>	36	9.55	286.52	10.61%	0.4003
<b>Round 2</b>	24	3.72	43.47	1.61%	0.1797
<b>Round 3</b>	12	0.81	2.06	0.08%	0.0602

# Spatial Shang

- The **Spatial Shang** (Di Zio S., Staniscia B., 2013) is a modified version of the Shang method.
- It is based on judgments of a panel of experts.
- The opinions are expressed by locating points on a map.

1. Draw 4 points on a map;
2. locate a single point in one of four rectangles.



# The Real-Time Spatial Delphi

Here we present the **Real-Time Spatial Delphi**, which combines the advantages of the **Real-Time Delphi** with those of the **Spatial Delphi**.

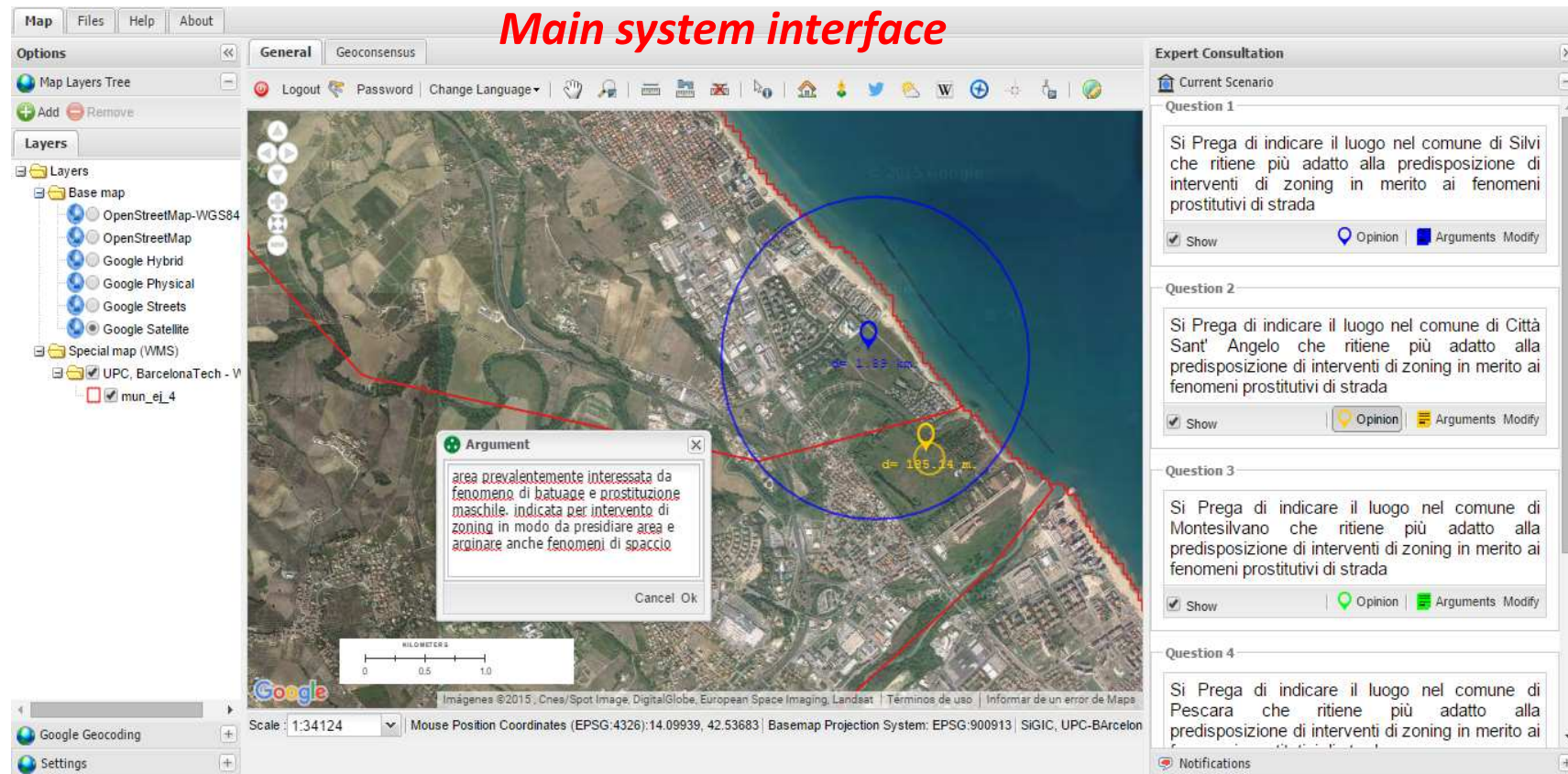
A panel of experts expresses **opinions-points on a digital map**, to reach a convergence of opinions on the location of goods, services or events (scenarios).

It is designed to **support decision-making** in complex situations.

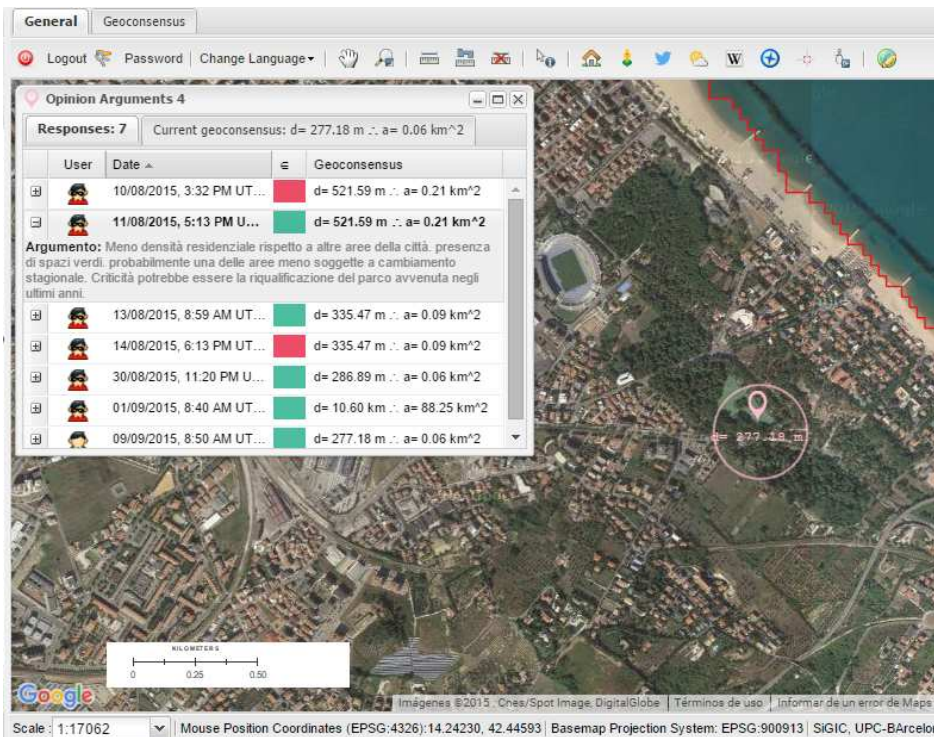
It can be used in **strategic planning** or **forecasting**.



# Key features of the system



- The user can give **opinion-points** and **comments**.
- The user can **change** his/her answers whenever it sees fit.
- The user can give **feedbacks** on the responses of the other (anonymous) panelists.
- After each point, the circle changes **position** and **dimension**



## In Real-Time the expert can:

- Consult accompanying **documents**
- See the **circle of consensus**

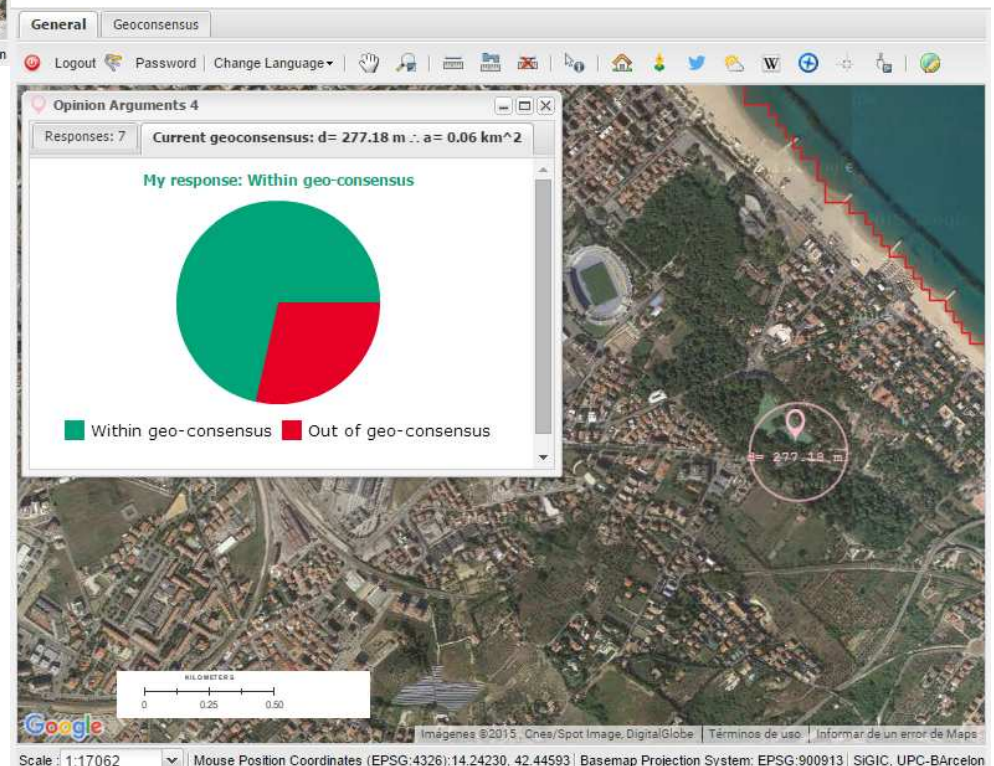
**SDSS**

Simple tools to promote **spatial consensus** in real-time

A GIS **user-friendly interface**

Any kind of **layer**

Any kind of **supporting** and/or **informative documents**



# Potential fields of application

- Logistics operations
- Management and environmental impact
- Generating policies
- Planning infrastructure and services
- Industrial planning
- Spatial planning
- Defence and security



# Running applications

1. Location of air quality **monitoring stations** (Pescara, Italy).
2. Location of monitoring sites for **HIV screening test** in pregnant women (Esmeraldas, Ecuador).
3. Location of points for **blood collection** (Cuenca, Ecuador).
4. Environmental planning and management in **scientific station** (Pedro Vicente Maldonado, Ecuador).
5. **Infrastructure and services** planning (Trempealeau-Montsec Basin, Spain).
6. **Environmental Impact Assessment** of wind energy (Mexico).
7. **Zoning** of street prostitution (Abruzzo, Italy).

General Geoconsensus Analysis Search

Logout Password Change Language Quick Search to visible layers

Expert Consultation

Current Scenario

Question 1

All'interno della città di Pescara, indicare il punto dove si ritiene più opportuno posizionare una stazione di monitoraggio (facendo riferimento alla tipologia T, ovvero "stazione da traffico in zona urbana residenziale"). Per rispondere, cliccare prima sul pulsante 'Opinione' e poi con il pulsante sinistro del mouse direttamente sulla mappa. Se possibile motivare la scelta. Si consideri che se sulla mappa appare un cerchio, quella è l'area dove gli altri esperti hanno concentrato le loro risposte.

Show Opinion Arguments Modify

Scale : 1:34124 Mouse Position Coordinates (EPSG:4326):14.17468, 42.47960 Basemap Projection System: EPSG:900913 SiGIC, UPC-Barcelon

Location of air quality monitoring stations (Pescara, Italy).

Location of monitoring sites for HIV screening test in pregnant women (Esmeraldas, Ecuador).

General Geoconsenso Analisis Busqueda

Consulta a Expertos

Escenario Actual

Cuestión 1

De acuerdo con los datos y estadísticas que muestran las mujeres embarazadas en la ciudad de Esmeraldas, y buscando atender la mayor cobertura de esta población ¿En donde considera usted que colocar un puesto para suministrar tamizaje seria más concurrido?

Visible Opinión Argumentos Modificar

Escala : 1:8531 Posición actual 'X', 'Y' (EPSG:4326):-79.66043, 0.97280 Proyección del mapa base: EPSG:900913 SiGIC, UPC-BarcelonaTech,



# Zoning of street prostitution

The zoning is a new approach which aims to **relocate the practice of prostitution** in areas characterized by low population density, the presence of law enforcement and social workers.

It is a **methodology of harm reduction**: increases the effectiveness of actions aimed at the welfare of citizens and that of prostitutes.



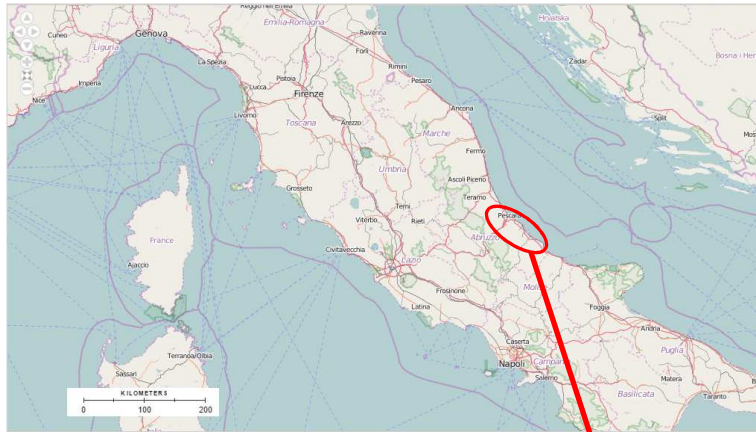
# Zoning of street prostitution

It is a **regulatory policy** that allows social workers and law enforcement:

- **be present** where the phenomenon of street prostitution emerges;
- develop effective **preventive health interventions**;
- protect the **safety of prostitutes**;
- **mediate conflicts** with citizens.

Since **zoning is a complex process** (involving many stakeholders) the phase of **finding a suitable place** on the territory **is crucial**.





# Study Area

5 municipalities

Abruzzo region, Italy

- A panel of seven experts
- A web platform specially designed

A screenshot of a web-based expert consultation platform. The main window displays a map of the study area, with five municipalities highlighted in red: Silvi, Città S. A., Montesilvano, Pescara, and Francavilla. The map includes a scale bar and a coordinate system. On the right side, there is a panel titled "Expert Consultation" with four questions for zoning assessment. The first question asks for the most suitable point for zoning. The second question asks for the most suitable location in Città Sant' Angelo for zoning interventions related to prostitution. The third question asks for the most suitable location in Montesilvano for zoning interventions related to prostitution. The fourth question asks for the most suitable location in Pescara for zoning interventions related to prostitution. The interface includes a "Map Layers Tree" on the left and a "Scale" and "Mouse Position Coordinates" bar at the bottom.



# RESULTS



# History of the movements of each circle

The screenshot displays the Geoconsensus web application interface. The main map area shows a satellite view of a coastal region with several blue circles overlaid, representing movement history. The interface includes a top navigation bar with tabs for Map, Metadata, Files, Consensus Charts, Admin, Help, and About. Below this is a toolbar with icons for various map functions. On the left, there is a 'Layers' panel with a 'Map Layers Tree' and a list of layers including 'Base map' (OpenStreetMap-WGS84, OpenStreetMap, Google Hybrid, Google Physical, Google Streets, Google Satellite) and 'Special map (WMS)' (UPC, BarcelonaTech - V, mur\_ej\_4). The bottom status bar shows the scale (1:135494), mouse position coordinates (EPSG:4326):14.01193, 42.61353, and the basemap projection system (EPSG:900913) SIGIC, UPC-BArcolon. On the right, the 'Expert Consultation' panel is active, displaying four questions in Italian regarding zoning interventions for prostitution in different municipalities: Silvi, Città Sant' Angelo, Montesivano, and Pescara. Each question has a 'Show' button and options for 'Opinion' and 'Arguments'.

Map Metadata Files Consensus Charts Admin Help About

Options General Geoconsensus Analysis Search

Map Layers Tree Add Remove

Layers Source Services

Layers

- Base map
  - OpenStreetMap-WGS84
  - OpenStreetMap
  - Google Hybrid
  - Google Physical
  - Google Streets
  - Google Satellite
- Special map (WMS)
  - UPC, BarcelonaTech - V
  - mur\_ej\_4

Scale: 1:135494 Mouse Position Coordinates (EPSG:4326):14.01193, 42.61353 Basemap Projection System: EPSG:900913 SIGIC, UPC-BArcolon

Expert Consultation

Current Scenario

Question 1

Si Prega di indicare il luogo nel comune di Silvi che ritiene più adatto alla predisposizione di interventi di zoning in merito ai fenomeni prostitutivi di strada

Show Opinion Arguments Modify

Question 2

Si Prega di indicare il luogo nel comune di Città Sant' Angelo che ritiene più adatto alla predisposizione di interventi di zoning in merito ai fenomeni prostitutivi di strada

Show Opinion Arguments Modify

Question 3

Si Prega di indicare il luogo nel comune di Montesivano che ritiene più adatto alla predisposizione di interventi di zoning in merito ai fenomeni prostitutivi di strada

Show Opinion Arguments Modify

Question 4

Si Prega di indicare il luogo nel comune di Pescara che ritiene più adatto alla predisposizione di interventi di zoning in merito ai fenomeni prostitutivi di strada

Notifications



# History of the opinion-points

The screenshot displays a web application interface for managing opinion points on a map. The main map area shows a satellite view of a coastal town with a red circle highlighting a specific area. A pop-up window titled "Opinion Arguments 5" is overlaid on the map, showing a table of responses and an argument.

**Opinion Arguments 5**

Responses: 7    Current geoconsensus: d= 1.86 km · a=

User	Date	Geoconsensus
[Avatar]	09/09/2015, 8...	d= 1.86 km · a= 2.72 km <sup>2</sup>
[Avatar]	01/09/2015, 8...	d= 1.86 km · a= 2.72 km <sup>2</sup>
[Avatar]	30/08/2015, 1...	d= 1.86 km · a= 2.72 km <sup>2</sup>
[Avatar]	14/08/2015, 6...	d= 2.07 km · a= 3.38 km <sup>2</sup>
[Avatar]	13/08/2015, 8...	d= 3.78 km · a= 11.24 k...
[Avatar]	11/08/2015, 4...	d= 3.72 km · a= 10.85 k...
[Avatar]	10/08/2015, 3...	d= 2.29 km · a= 4.11 km <sup>2</sup>

**Argumento:** Area di Francavilla scarsamente abitata, quindi particolarmente densa a lotteico intervento di zoning.

Scale: 1:14124    Mouse Position Coordinates (EPSG:4326):14.21120, 42.46212 | Basemap Projection System: EPSG:900913 | SGIC, UPC-BArodon

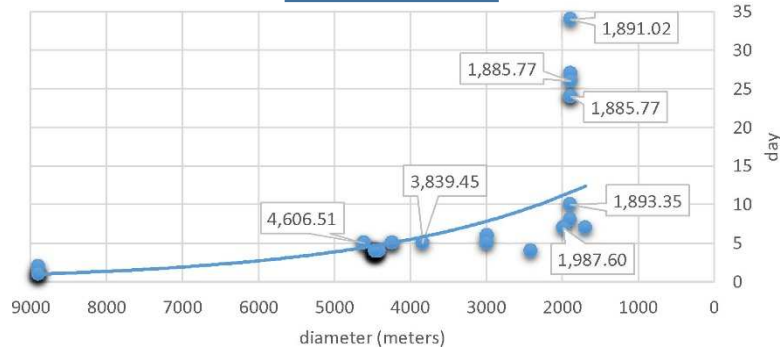
# Descriptive Statistics

Municipality	surface (Km <sup>2</sup> )			Measure of cons.	No. of experts	No. of opinions
	Initial circle	Minimal obtained	Final circle			
<b>1</b> Silvi	62.180	2.258	2.809	<b>4.52%</b>	7	34
<b>2</b> Città S. A.	162.860	0.029	0.027	<b>0.02%</b>	7	40
<b>3</b> Montesilv.	41.396	0.082	0.314	<b>0.76%</b>	6	35
<b>4</b> Pescara	88.247	0.060	0.060	<b>0.07%</b>	7	24
<b>5</b> Francavilla	60.545	2.716	2.722	<b>4.50%</b>	7	27

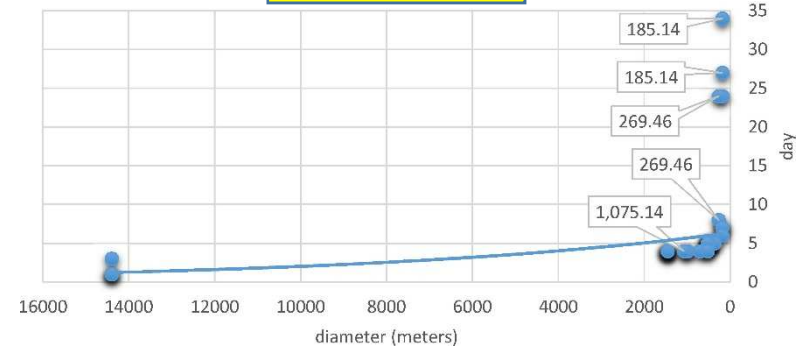


# History of the geo-consensus

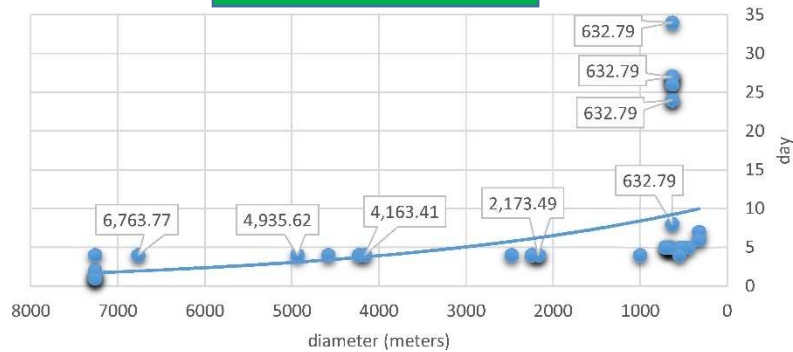
## 1. Silvi



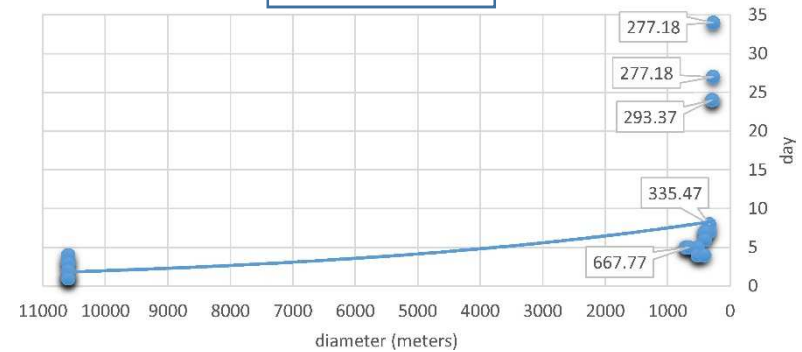
## 2. Città S. A.



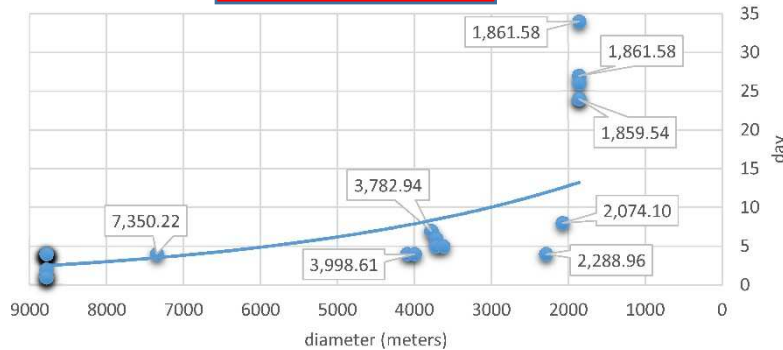
## 3. Montesilvano



## 4. Pescara



## 5. Francavilla



# Arguments

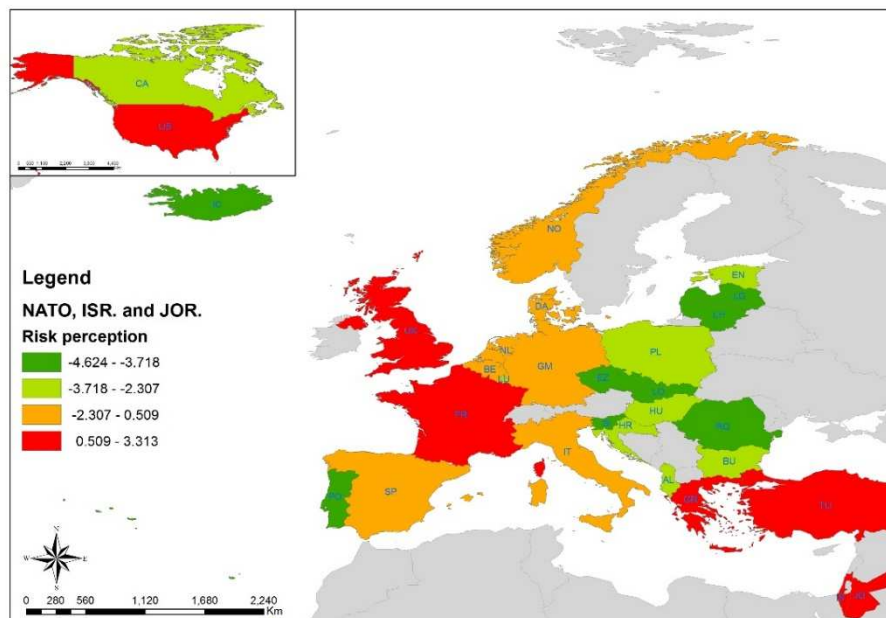
iduser	user	ema	date_hou	date	argument	idquestio	municipa	question
63	somn	som	07 Aug 20	#####	Quest area Ã" giÃ interessata attualmente dal fenomeno. Ha giÃ creato un impatto sulla vita cittadina,	32	Città Sant'	Si Prega di
58	ippoli	ippo	09 Aug 20	#####	Zona conosciuta come il viale del battuage. Scambi di coppia ed incontri prettamente omosessuali. Pros	32	Città Sant'	Si Prega di
57	giada	giad	10 Aug 20	#####	zona lontana dagli occhi della gente, zona specifica per incontri tra omosessuali	32	Città Sant'	Si Prega di
58	ippoli	ippo	10 Aug 20	#####	Zona conosciuta come il viale del battuage. Scambi di coppia ed incontri prettamente omosessuali. Pros	32	Città Sant'	Si Prega di
59	lidiafi	lidiaf	10 Aug 20	#####	Zona isolata rispetto al resto del contesto urbano, che potrebbe risultare particolarmente indicata per i	32	Città Sant'	Si Prega di
63	somn	som	10 Aug 20	#####	la lontananza dal circuito cittadino potrebbe consentire la messa in opera di uno spazio ad hoc in cui viv	32	Città Sant'	Si Prega di
56	a.salv	a.sal	11 Aug 20	#####		32	Città Sant'	Si Prega di
61	marcf	marc	11 Aug 20	#####	Vita notturna estiva e vie di comunicazione molto frequentate	32	Città Sant'	Si Prega di
58	ippoli	ippo	12 Aug 20	#####	Zona conosciuta come il viale del battuage. Scambi di coppia ed incontri prettamente omosessuali. Pros	32	Città Sant'	Si Prega di
61	marcf	marc	13 Aug 20	#####	Vita notturna estiva e vie di comunicazione molto frequentate	32	Città Sant'	Si Prega di
61	marcf	marc	13 Aug 20	#####	Vita notturna estiva e vie di comunicazione molto frequentate	32	Città Sant'	Si Prega di
61	marcf	marc	13 Aug 20	#####	Vita notturna estiva e vie di comunicazione molto frequentate	32	Città Sant'	Si Prega di
58	ippoli	ippo	14 Aug 20	#####	Zona conosciuta come il viale del battuage. Scambi di coppia ed incontri prettamente omosessuali. Pros	32	Città Sant'	Si Prega di
60	lamel	lame	30 Aug 20	#####	area prevalentemente interessata da fenomeno di batuage e prostituzione maschile. indicata per interv	32	Città Sant'	Si Prega di
63	somn	som	30 Aug 20	#####	la lontananza dal circuito cittadino potrebbe consentire la messa in opera di uno spazio ad hoc in cui viv	32	Città Sant'	Si Prega di
60	lamel	lame	02 Sep 20	#####	area prevalentemente interessata da fenomeno di batuage e prostituzione maschile. indicata per interv	32	Città Sant'	Si Prega di
60	lamel	lame	09 Sep 20	#####	area prevalentemente interessata da fenomeno di batuage e prostituzione maschile. indicata per interv	32	Città Sant'	Si Prega di
63	somn	som	07 Aug 20	#####	Quest area Ã" giÃ interessata attualmente dal fenomeno. Ha giÃ creato un impatto sulla vita cittadina,	35	Francavilla	Si Prega di
58	ippoli	ippo	08 Aug 20	#####	Ad oggi il fenomeno della prostituzione a Francavilla si divide prettamente su due aree, meglio definirle	35	Francavilla	Si Prega di
57	giada	giad	10 Aug 20	#####	la zona di Francavilla prima era caratterizzata per la presenza di Night, e prostituzione in appartamento	35	Francavilla	Si Prega di
58	ippoli	ippo	10 Aug 20	#####	In questa area commerciale troviamo molte zone libere, non prettamente residenziali ed Ã" un punto c	35	Francavilla	Si Prega di
59	lidiafi	lidiaf	10 Aug 20	#####		35	Francavilla	Si Prega di
63	somn	som	10 Aug 20	#####	Quest area Ã" giÃ interessata attualmente dal fenomeno. Ha giÃ creato un impatto sulla vita cittadina,	35	Francavilla	Si Prega di
56	a.salv	a.sal	11 Aug 20	#####	Area di Francavilla scarsamente abitata, quindi particolarmente idonea a ipotetico intervento di zoning.	35	Francavilla	Si Prega di
61	marcf	marc	11 Aug 20	#####	diffusione di prostituzione in case private. DifficoltÃ di accesso e di incontro con le ragazze coinvolte.	35	Francavilla	Si Prega di
58	ippoli	ippo	12 Aug 20	#####	In questa area commerciale troviamo molte zone libere, non prettamente residenziali ed Ã" un punto c	35	Francavilla	Si Prega di
61	marcf	marc	13 Aug 20	#####	diffusione di prostituzione in case private. DifficoltÃ di accesso e di incontro con le ragazze coinvolte.	35	Francavilla	Si Prega di



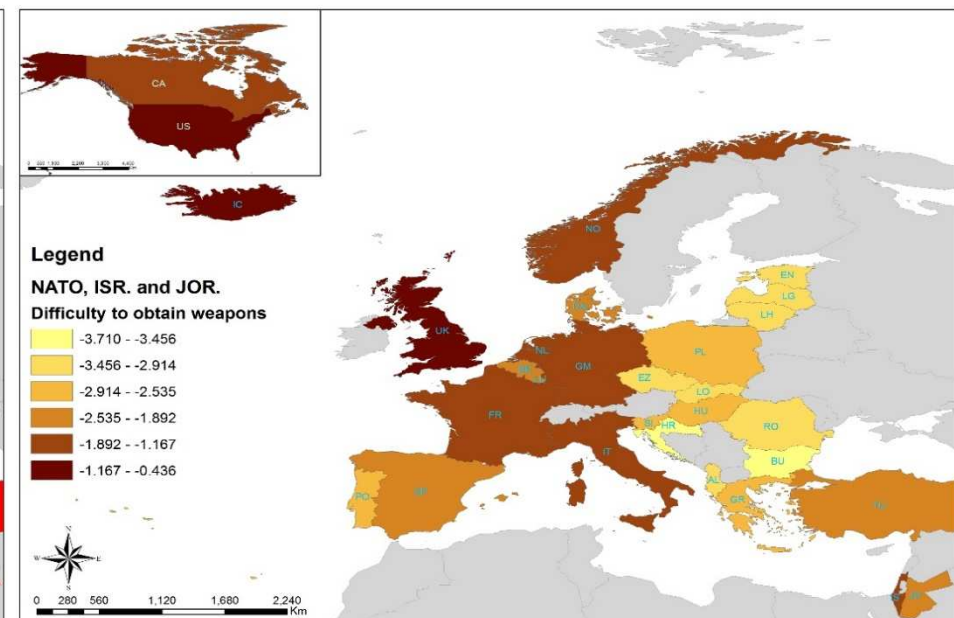
# Geo Real Time Delphi

## Lone Wolf Terrorism threats in NATO countries

(S. Di Zio, T. Gordon, Y. Sharan)



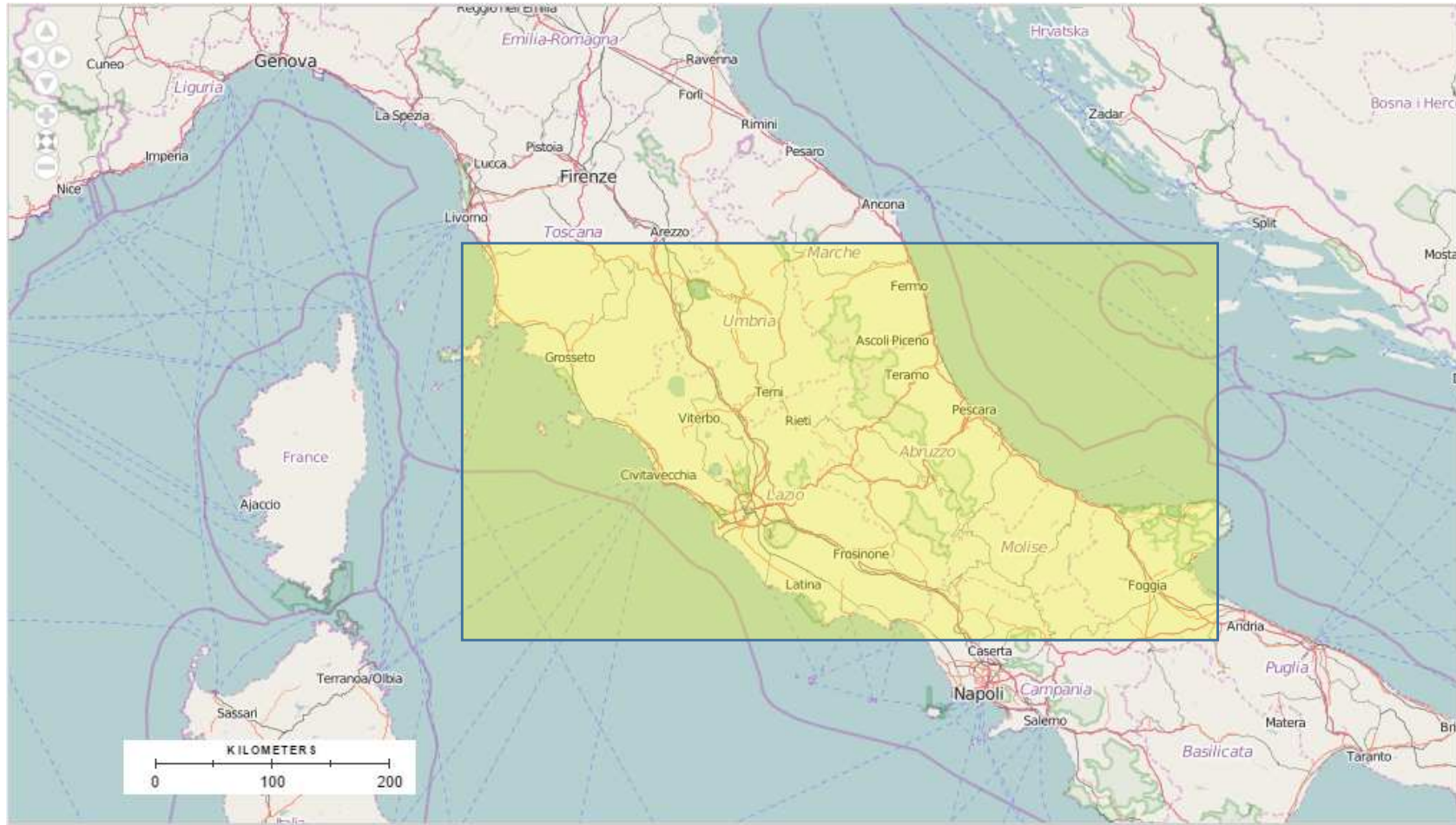
IRT model Estimates:  
perception of the risk of a  
LWT attack



IRT model Estimates:  
difficulty to obtain a WMD



# Real Time Spatial Shang



**Thanks for your attention**

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