

EUROGI Members Meeting  
"Geospatial & Digital Transformation key  
for Industrial Revolution 4.0 and Society"  
April 26th, Fisciano, Università di Salerno,  
Dipartimento di Informatica



## Spatial Information in supporting environmental planning and disaster management

*Beniamino Murgante*

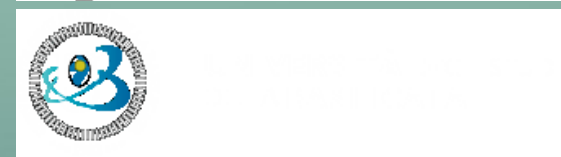
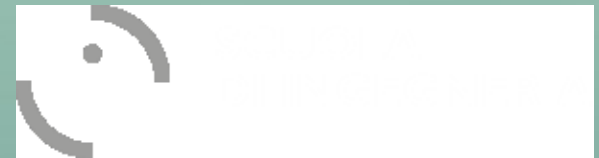
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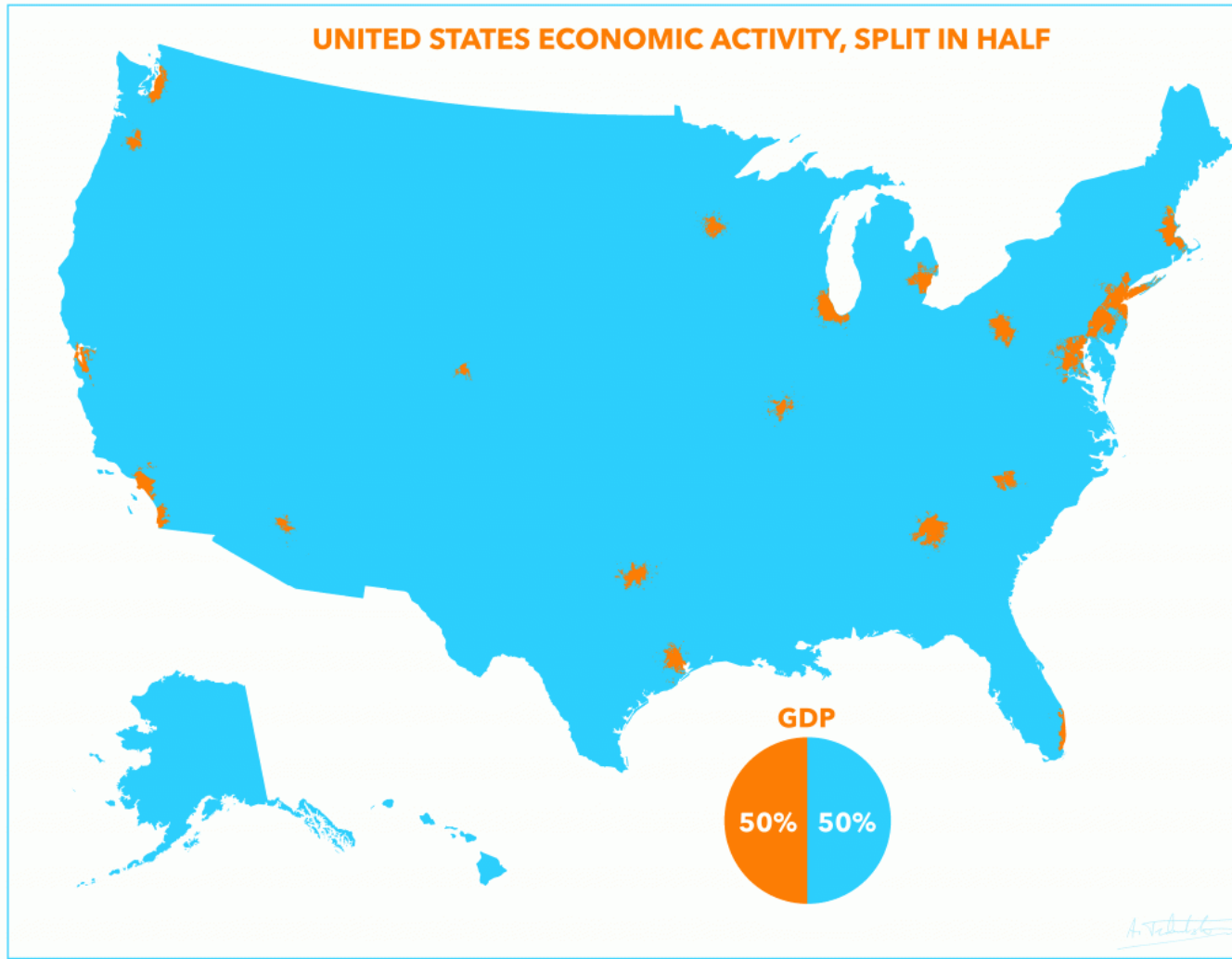
*beniamino.murgante@unibas.it*

*<http://oldwww.unibas.it/utenti/murgante/Benny.html>*

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*[https://www.researchgate.net/profile/Beniamino\\_Murgante](https://www.researchgate.net/profile/Beniamino_Murgante)*





Cities are the  
economic heart  
of America

[http://www.washingtonpost.com/blogs/the-fix/wp/2014/02/19/you-might-not-like-big-cities-but-you-need-them/?tid=sm\\_fb](http://www.washingtonpost.com/blogs/the-fix/wp/2014/02/19/you-might-not-like-big-cities-but-you-need-them/?tid=sm_fb)

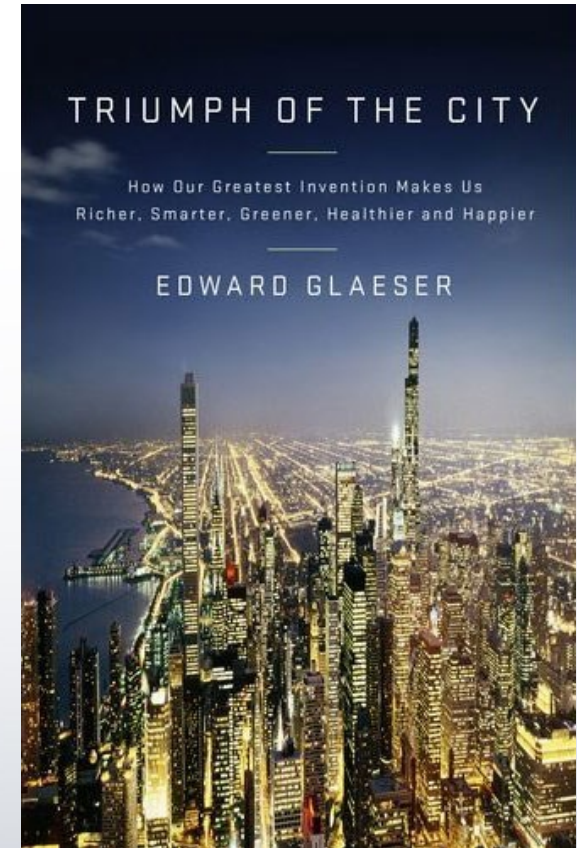
The following table ranks the gross domestic products of nations across the world alongside the gross metro product of the 50 biggest U.S. cities.

Rank	Country or Metro Area	2011 GDP or GMP (in billions)
1	United States	\$15,094.0
2	China	\$7,298.9
3	Japan	\$5,869.1
4	Germany	\$3,569.5
5	France	\$2,774.4
6	Brazil	\$2,476.7
7	United Kingdom	\$2,416.4
8	Italy	\$2,198.0
9	India	\$1,897.9
10	Russia	\$1,857.9
11	Canada	\$1,739.4
12	Spain	\$1,492.5
13	Australia	\$1,483.8
14	<b>New York-Northern New Jersey-Long Island, NY-NJ-PA</b>	\$1,287.7
15	Mexico	\$1,154.1
16	South Korea	\$1,116.4
17	Indonesia	\$846.8
18	Netherlands	\$837.8
19	Turkey	\$773.1
20	<b>Los Angeles-Long Beach-Santa Ana, CA</b>	\$755.0
21	Switzerland	\$637.7
22	Saudi Arabia	\$576.8
23	<b>Chicago-Joliet-Naperville, IL-IN-WI</b>	\$546.8
24	Sweden	\$537.7
25	Poland	\$514.3
26	Belgium	\$512.6
27	Iran	\$499.7
28	Norway	\$485.2

<http://blogs.wsj.com/economics/2012/07/20/u-s-cities-with-bigger-economies-than-entire-countries/tab/interactive/>



Cities play a central role for humanity, offering the opportunity to learn from each other face to face.







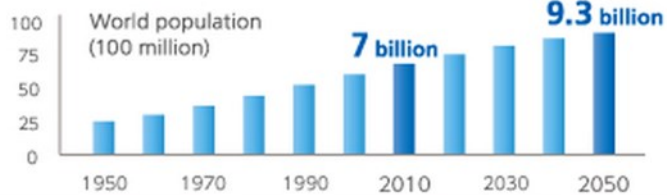
Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody.  
(Jane Jacobs)



All of us articulate our understanding of the city in different ways, thus implying that cities are kaleidoscopes of plurality, a multiplicity of ideas, perceptions, theories, models.  
(Batty, 2013)

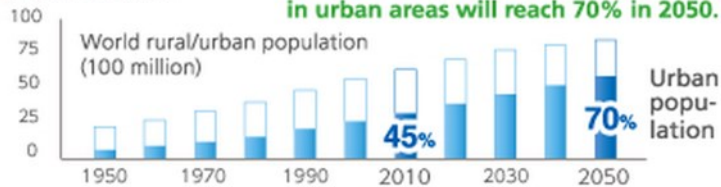
# Spatial Information in supporting environmental planning and disaster management

## Increase in population



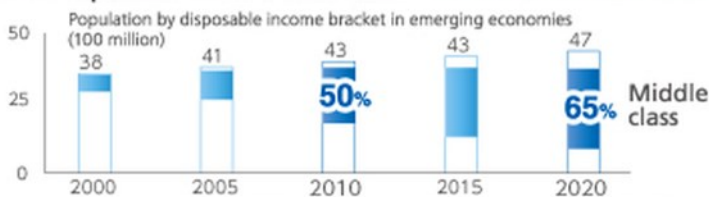
Source: State of World Population, United Nations

## Urbanization



Source: World Urbanization Prospects, United Nations (2010)

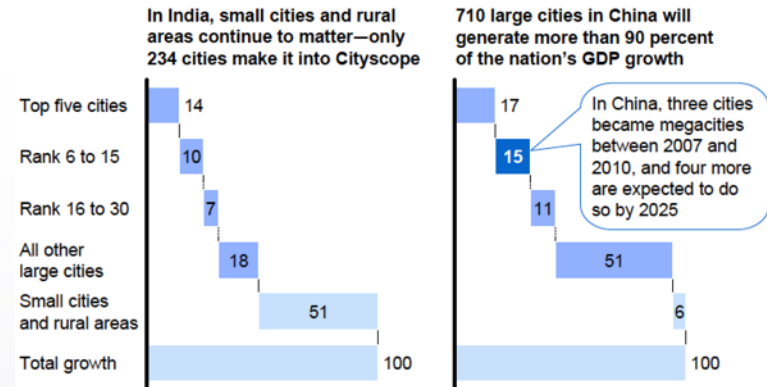
## Increase in energy consumption due to the expansion of the middle class



Source: White Paper on International Economy and Trade 2011, the Japanese Ministry of Economy, Trade and Industry

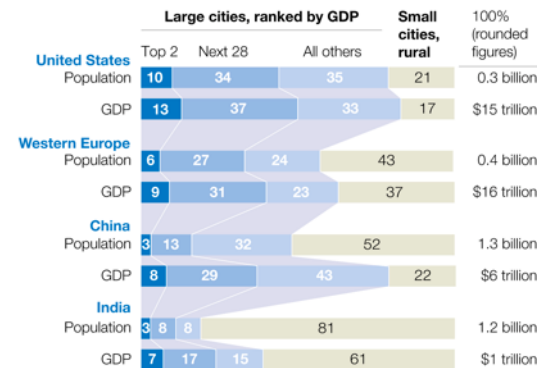
While India is still at an early stage of urbanization, China will continue to see rapid growth across cities of all sizes including rising megacities

Contribution to country GDP growth, 2010–25 %



SOURCE: McKinsey Global Institute Cityscope 1.5

Cities segmented by contribution to total GDP, 2010, cumulative % of total<sup>1</sup>



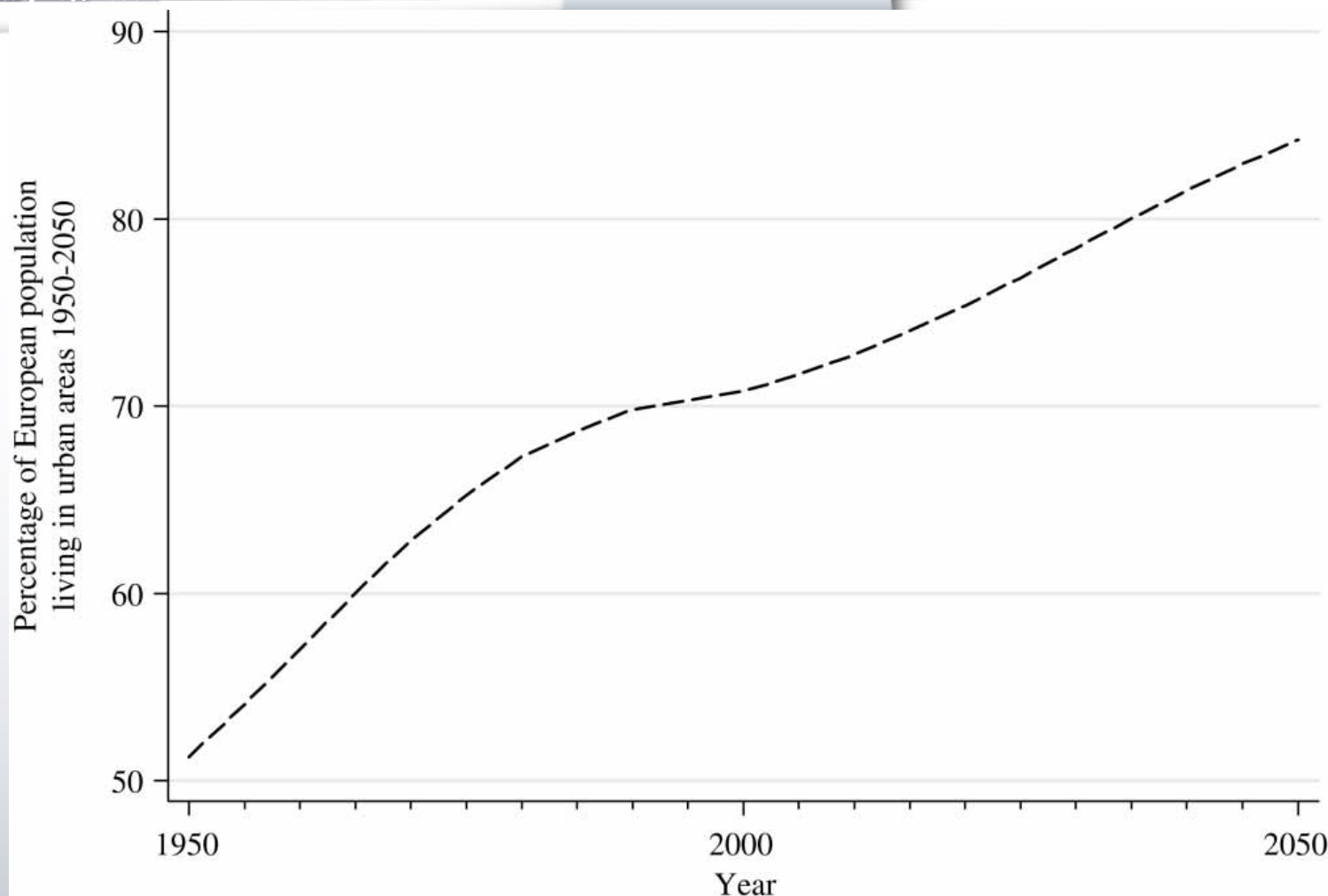
<sup>1</sup>GDP measured at real exchange rate; some figures may not sum to 100%, because of rounding.

Source: McKinsey Global Institute analysis

<http://www.smartcity-planning.co.jp/en/outline/index.html>

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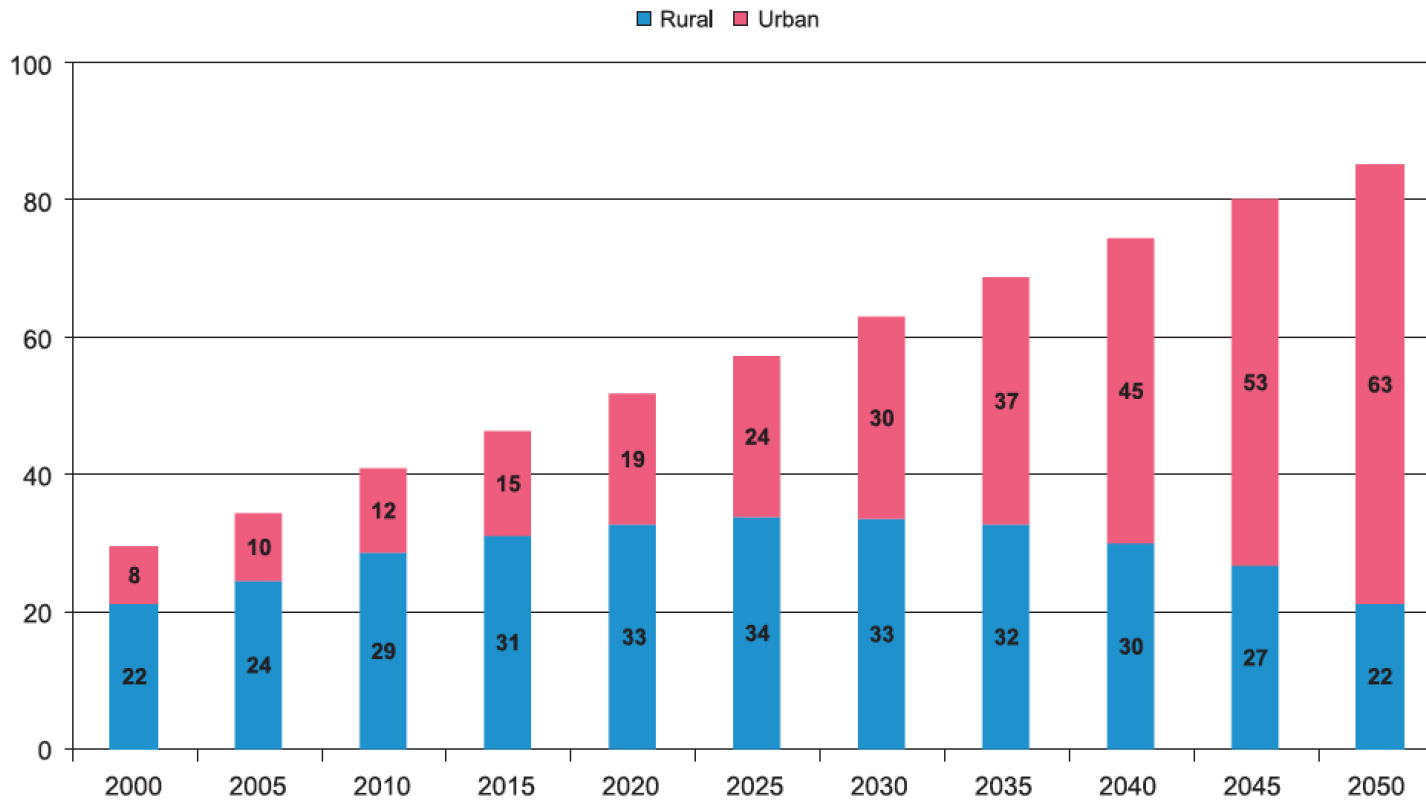




Percentage of EU population living in urban areas, 1950-2050 (forecast)

Source: UN (2009)

## An urban future: Kenya's population growth



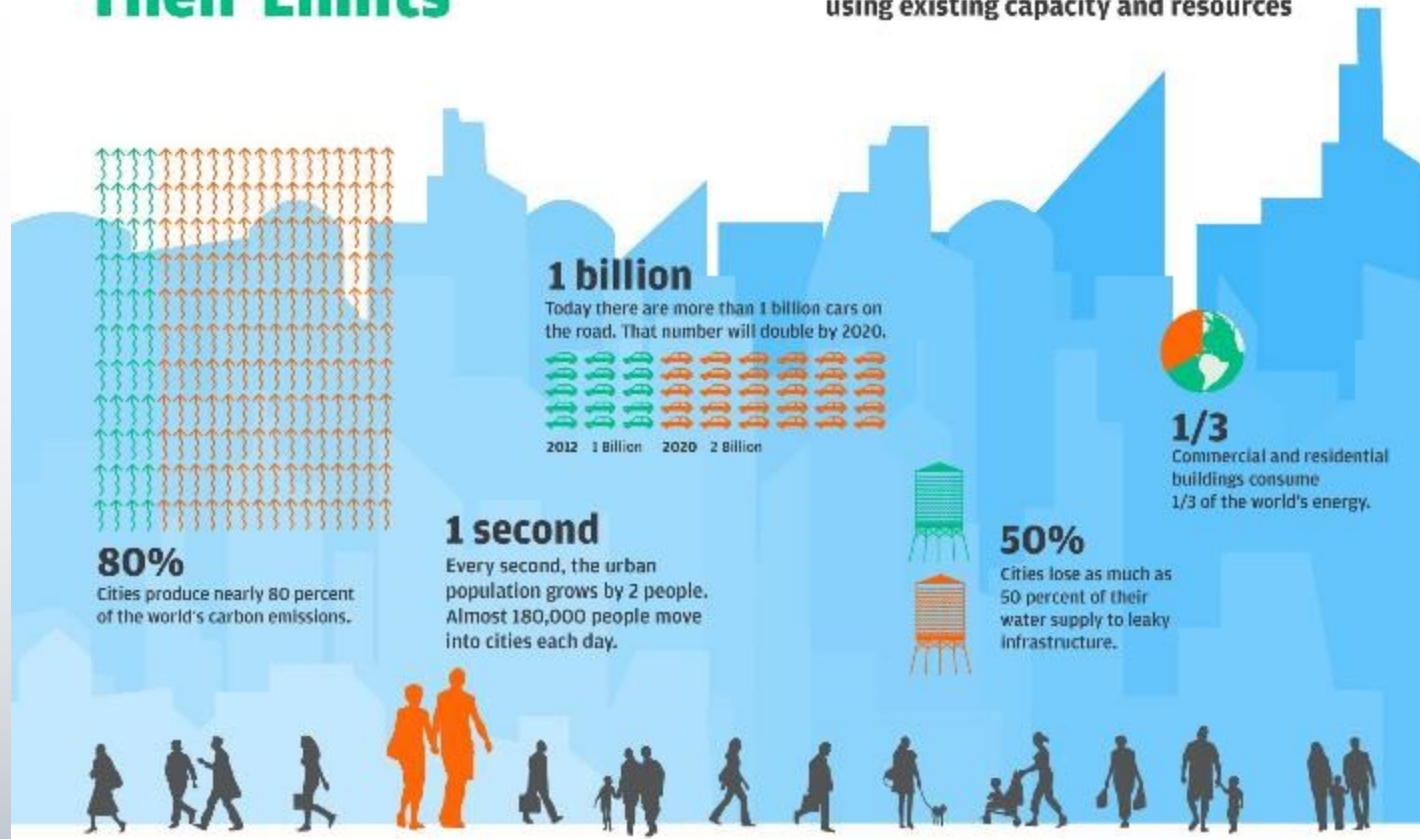
\*Includes core- and peri-urban residents.

Note: Population growth projections are World Bank computations based on data from KNBS and UN, DESA (Source: World Bank)



## Cities are Reaching Their Limits

Cities must become smarter about  
using existing capacity and resources



# The Urban Effect

## Examining the Impact of the Growth of Cities

In 1950, New York City was the only megacity with a population of more than 10 million people. By 2015, the United Nations estimates there will be 22 megacities.

**80%**

Cities produce nearly 80 percent of the world's carbon emissions.



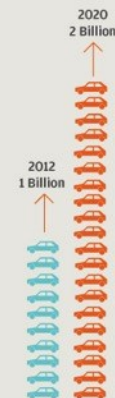
**45**

China will build another 45 airports during the next five years.



**1 billion**

Today there are more than 1 billion cars on the road. That number will double by 2020.



**1/3**

Commercial and residential buildings consume 1/3 of the world's energy.

**75%**

Cities consume an estimated 75 percent of the world's energy.



**50%**

Cities lose as much as 50 percent of their water supply to leaky infrastructure.

**1 second**



Every second, the urban population grows by 2 people. Almost 180,000 people move into cities each day.



## Dharavi: 240-hectare slum in central Mumbai



<http://archive.indianexpress.com/news/dharavi-development-project-inches-ahead/1153592/>





## Informal settlements (South East Asia)





## Informal settlements: Nairobi





"the paradox of the great civilization change consists in the fact that we have practically unlimited access to information and data and yet we are nearly unable to use it in any way".  
Manuel Castels 2009

Data is the new oil  
Models are the new gold  
Clive Humby

Ecological Informatics 30 (2015) 365–378



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## Supporting planning activities with the assessment and the prediction of urban sprawl using spatio-temporal analysis



Federico Amato, Piergiuseppe Pontrandolfi, Beniamino Murgante \*

*School of Engineering, University of Basilicata, Viale dell'Ateneo Lucano 10, Potenza, 85100, Italy*

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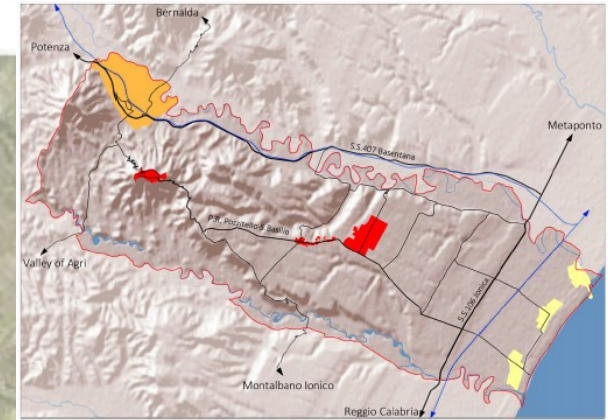
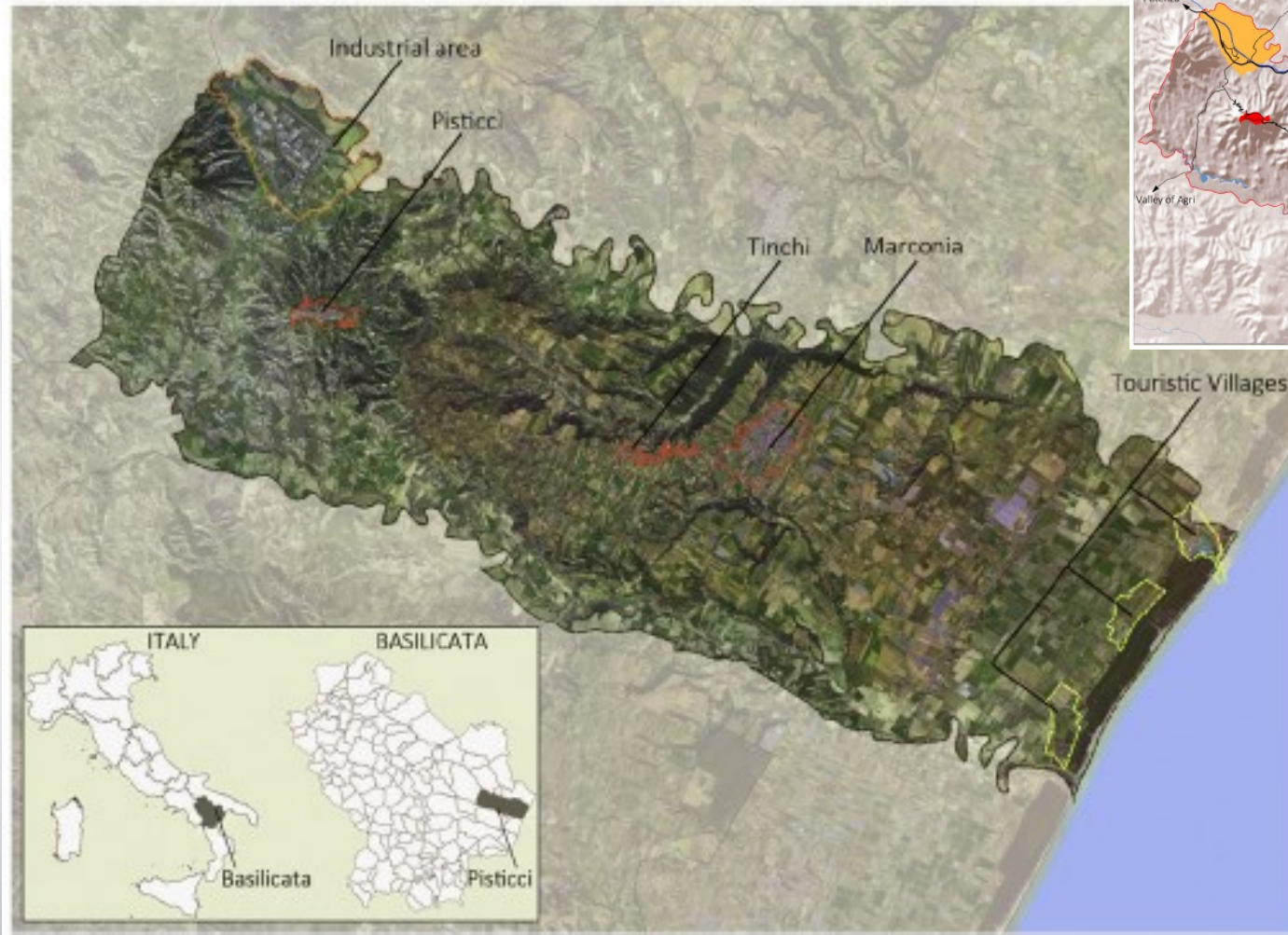
### ABSTRACT

The inestimable value of soil is exemplarily summarized in the definition provided by the European Union (2006), which considers it as "the upper layer of the earth's crust, formed by mineral particles, organic matter, water, air and living organisms".

The importance of soil protection is now universally recognized, but despite a lot of debates and principle's enunciation, in the last decades soil was consumed at a rate of 8 m<sup>2</sup> per second. The aim of this study is to propose a model which, on one side, is able to measure variations occurred in land use, and, therefore, to determine soil consumption, and, on the other side, is capable to predict future changes. Specifically, a simulation model has been proposed based on two methods: Joint information uncertainty and Weights of Evidence in order to analyse and predict new built-up areas. The proposed model has been applied to Pisticci Municipality in Basilicata region (Southern Italy). This area is a significant example, because of its high landscape value and, at the same time, of a lot of developing pressure due to touristic activities along the coastal zone.

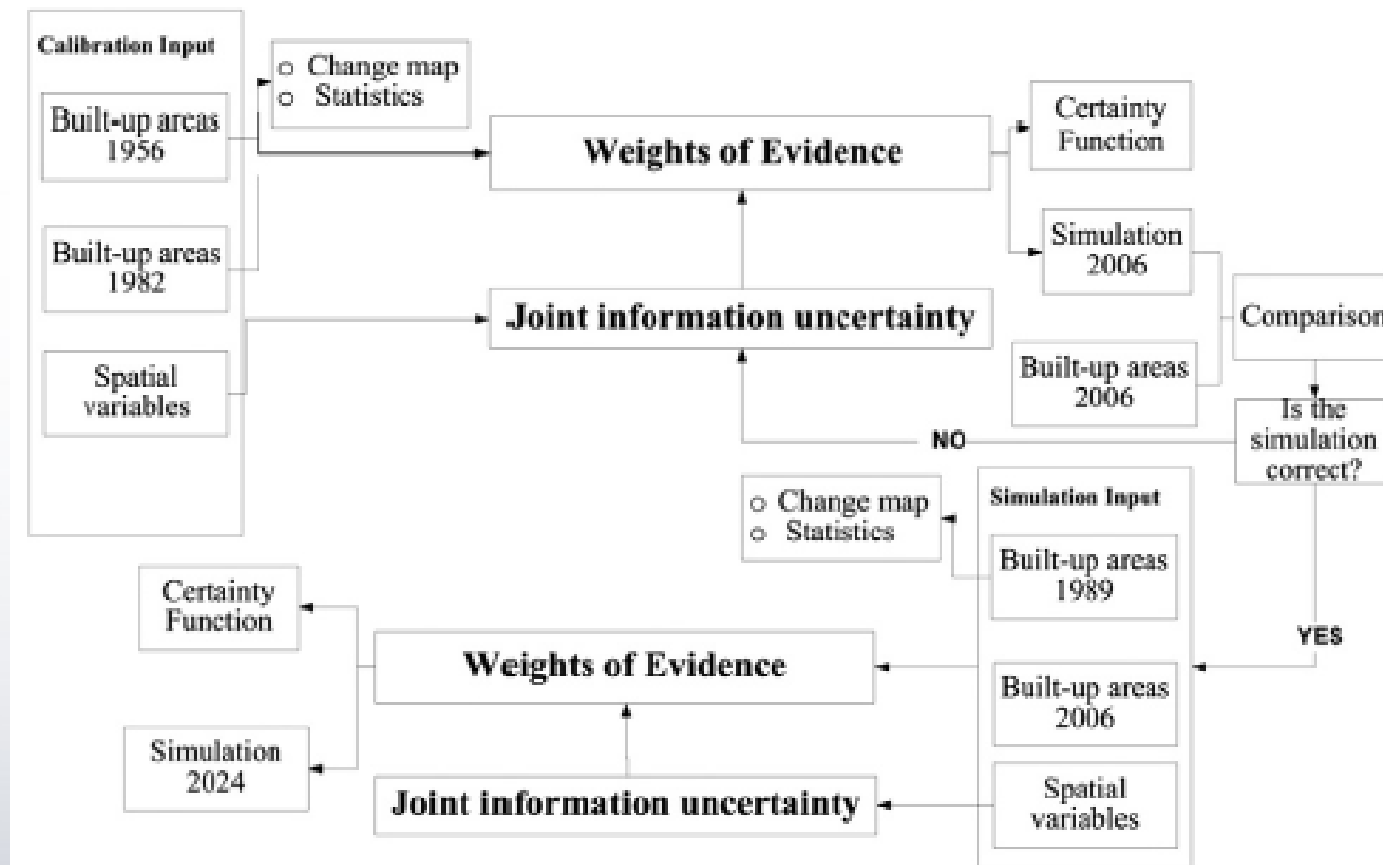
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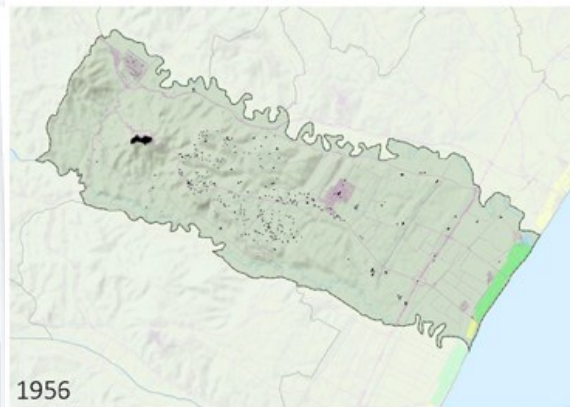


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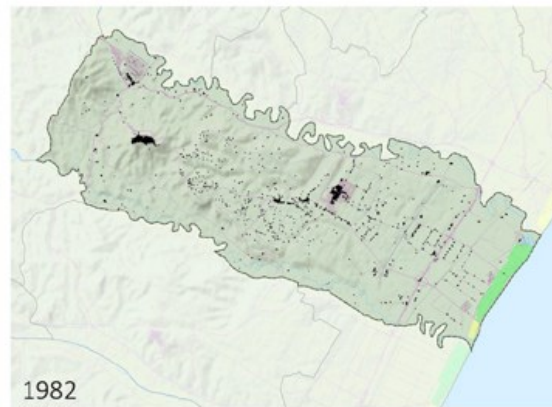




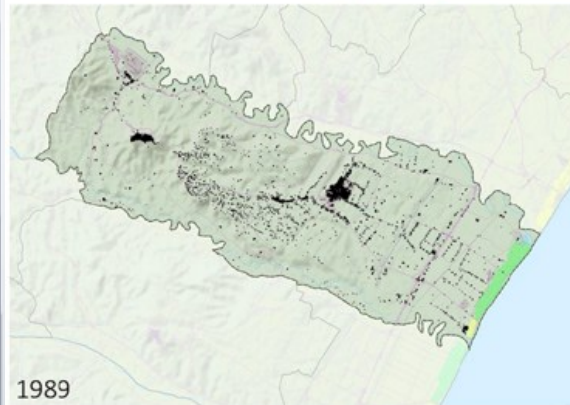
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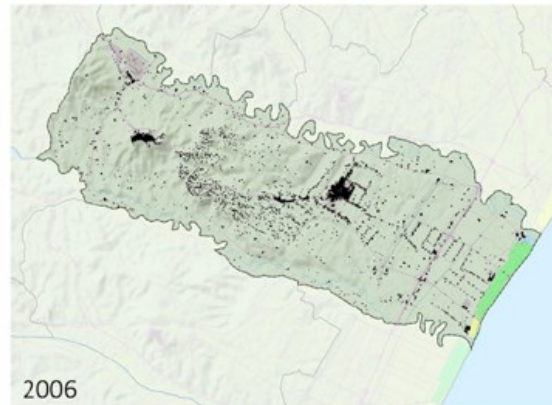
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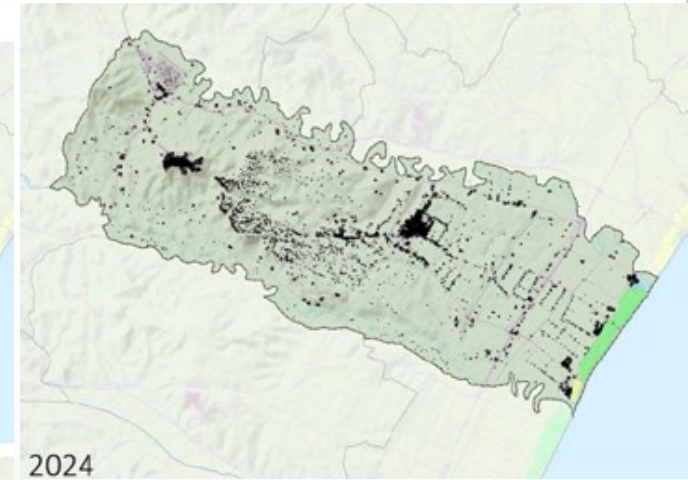
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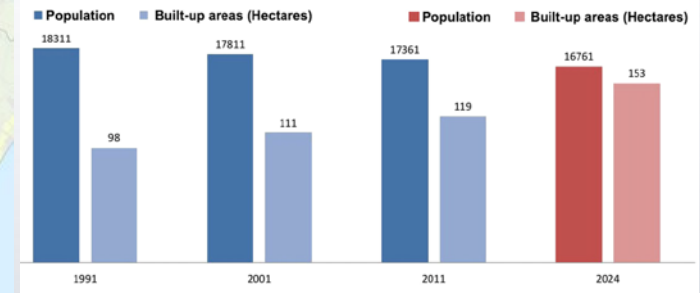
1989



2006



2024



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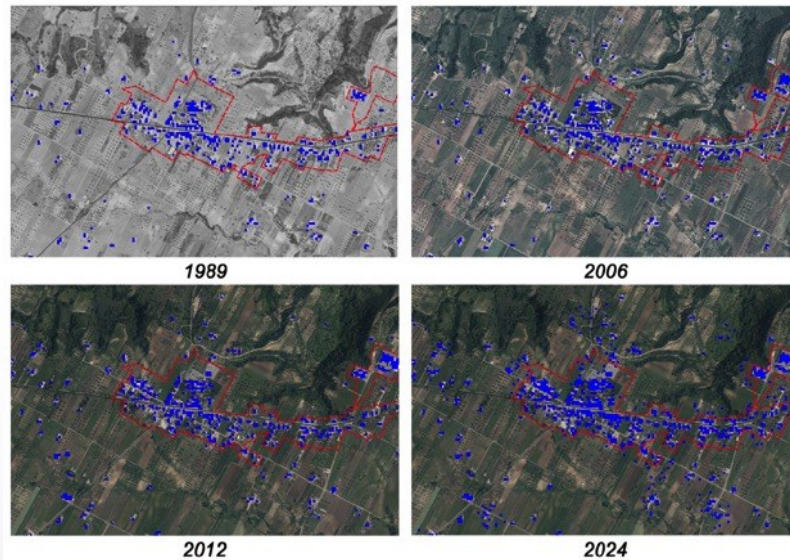


Fig. 8. The hamlet of Tinchì, highlighted by the red dashed line; blue pixels identify buildings at different dates.

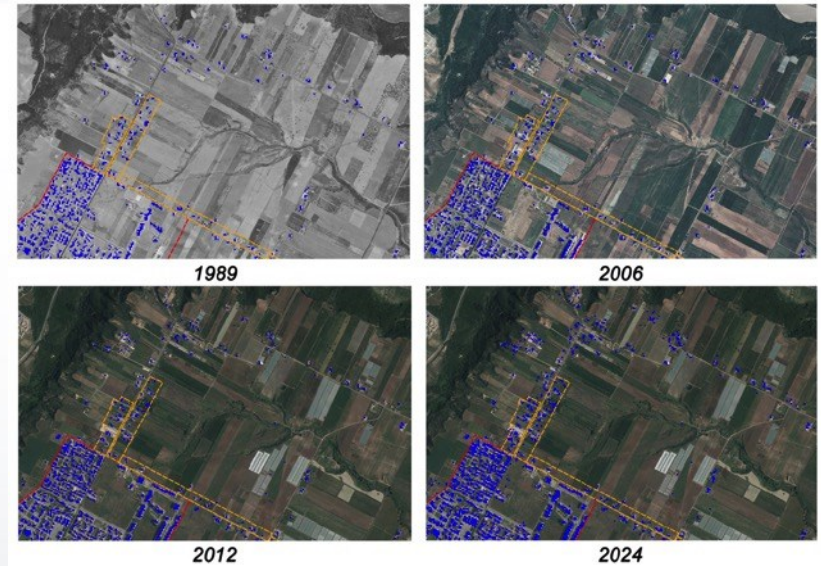


Fig. 9. The hamlet of Marconia, highlighted by the red dashed line; blue pixels identify buildings at different dates.

	1956	1982	1989	2006	2012	$\Delta$ 56-12	$\Delta$ 12-24	2024
<i>Pisticci Municipality</i>	28	58	98	111	125	97	28	153
<i>Tinchì</i>	1.62	6.05	9.06	9.73	10.43	8.81	5.72	16.15
<i>Marconia</i>	1.19	8.91	26.39	28.10	30.59	29.4	7.10	37.69
<i>F. Terrupo</i>	0.95	1.03	2.04	3.06	3.27	2.32	0.40	3.67
<i>S. Leonardo</i>	1.32	1.39	3.48	4.38	4.82	3.50	1.24	6.06
<i>Coastal area</i>	0.14	0.85	3.95	7.94	15.68	15.54	7.01	22.69

Quantity of  
built-up  
areas [ha]  
measured at  
different  
times.

Amato, F., Pontrandolfi, P., Murgante, B., 2015, Supporting planning activities with the assessment and the prediction of urban sprawl using spatio-temporal analysis, *Ecological Informatics*, Volume 30, November 2015, Pages 365-378 doi:10.1016/j.ecoinf.2015.07.004



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## Preserving cultural heritage by supporting landscape planning with quantitative predictions of soil consumption



Federico Amato<sup>a</sup>, Federico Martellozzo<sup>b</sup>, Gabriele Nolè<sup>c</sup>, Beniamino Murgante<sup>a,\*</sup>

<sup>a</sup> School of engineering, University of Basilicata, 10, viale dell'Ateneo Lucano, 85100 Potenza, Italy

<sup>b</sup> University of Rome "La Sapienza", 9, via Del Castro Laurenziano, 00161 Roma, Italy

<sup>c</sup> Italian National Research Council, IMAA C.da Santa Loja, Tito Scalo, 85050 Potenza, Italy

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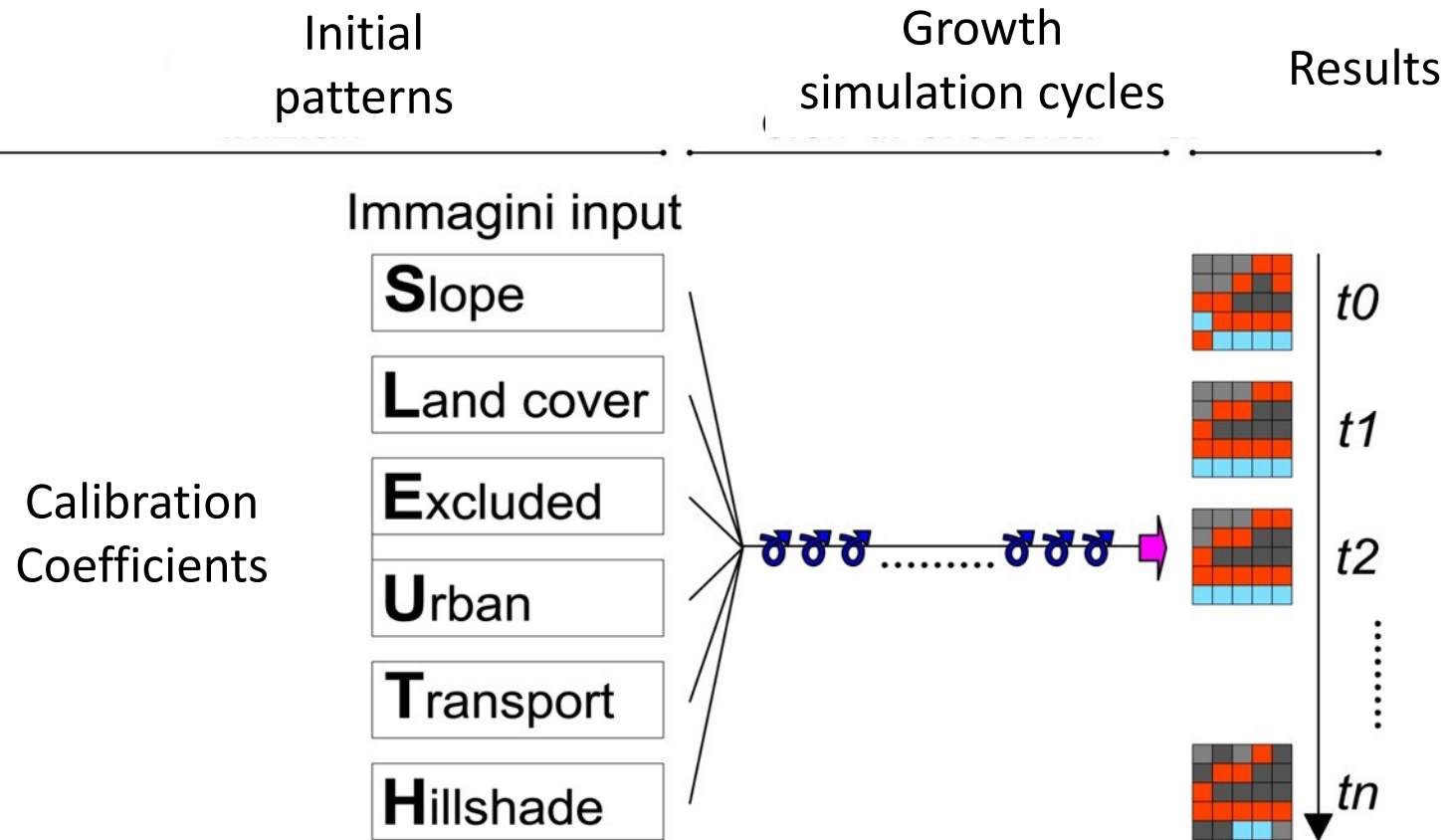
Built-up areas

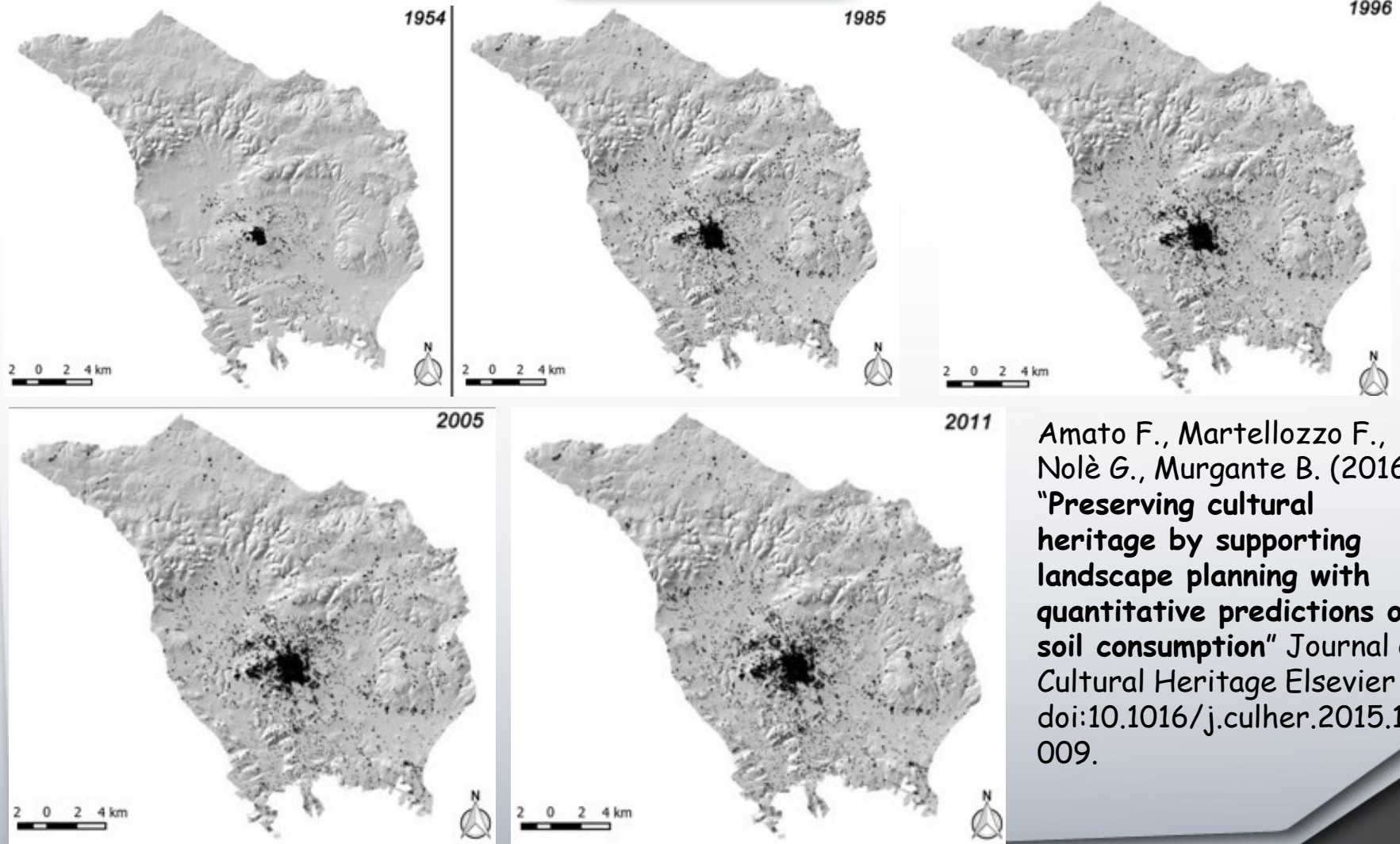
### ABSTRACT

Landscape preservation in Italy is a major issue in national cultural heritage conservation policies. Urban settlements growth is among the most threatening factors for the correct landscape preservation. Such phenomenon may result in corrupting the correct landscape-system functioning, particularly when the development occurs without precise planning prescriptions. Land-use/cover evolution dynamic is a subject widely and thoroughly investigated, especially concerning consumption of natural and other lands due to anthropogenic activities. This paper focuses on a region in southern Italy, where soil consumption is known to represent a urging matter of concern. However, although the negative impacts of soil consumption are well known, to our knowledge there are no case studies presenting a precise quantitative assessment of the intensity of such phenomenon for the region of interest. Furthermore, this study aims at forecasting the development of urban settlements through the application of the cellular automata model SLEUTH; the case study concerns the Municipality of Altamura (Apulia region, Italy). Results highlight how current landscape preservation instruments alone cannot ensure a reduction in soil consumption phenomenon and how urban areas expansion is incompatible with a correct landscape conservation in the study area.

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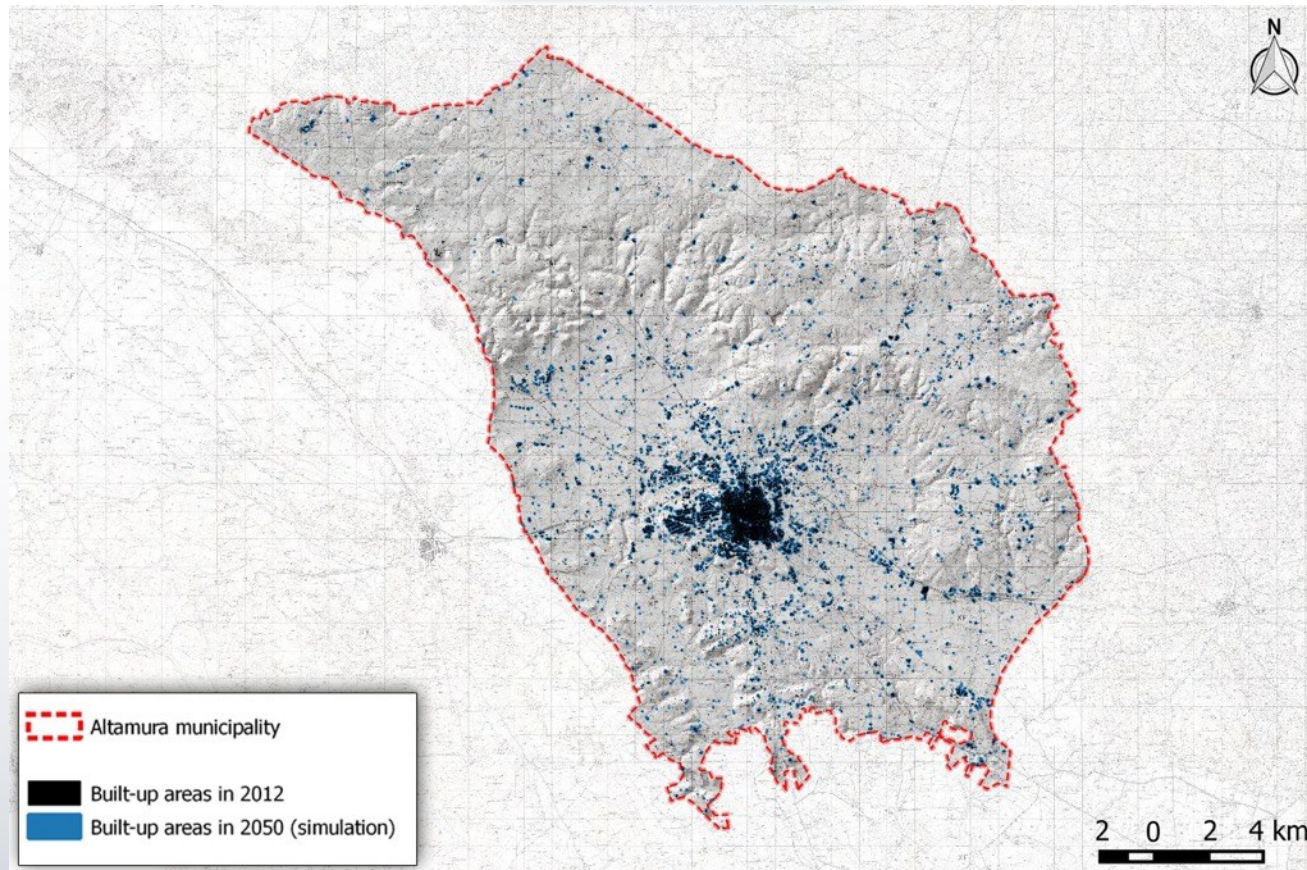






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## The Effects of Urban Policies on the Development of Urban Areas

Federico Amato <sup>1</sup> , Biagio Antonio Malmone <sup>1</sup> , Federico Martellozzo <sup>2,\*</sup> , Gabriele Nolè <sup>3</sup> and Beniamino Murgante <sup>1</sup>

<sup>1</sup> School of Engineering, University of Basilicata, Viale dell'Ateneo Lucano 10, 85100 Potenza, Italy

<sup>2</sup> Department of Methods and Models for Economics, University of Rome "La Sapienza", Via Del Castro Laurenziano 9, 00161 Roma, Italy

<sup>3</sup> Italian National Research Council, IMAA C.da Santa Loja, Tito Scalo, Potenza 85050, Italy

\* Author to whom correspondence should be addressed.

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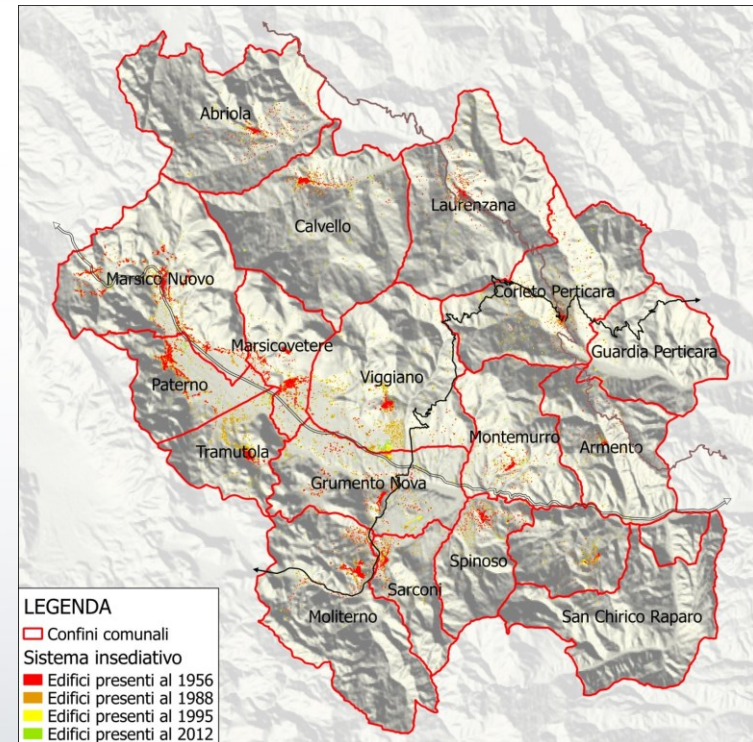
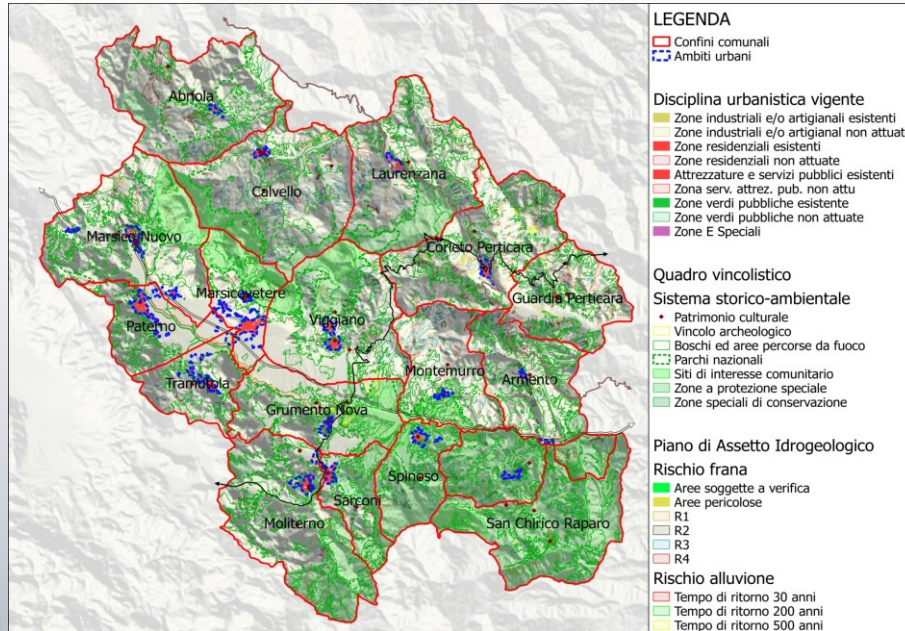
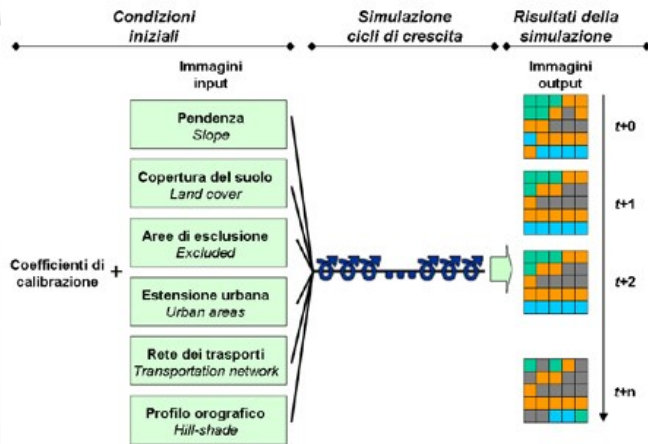
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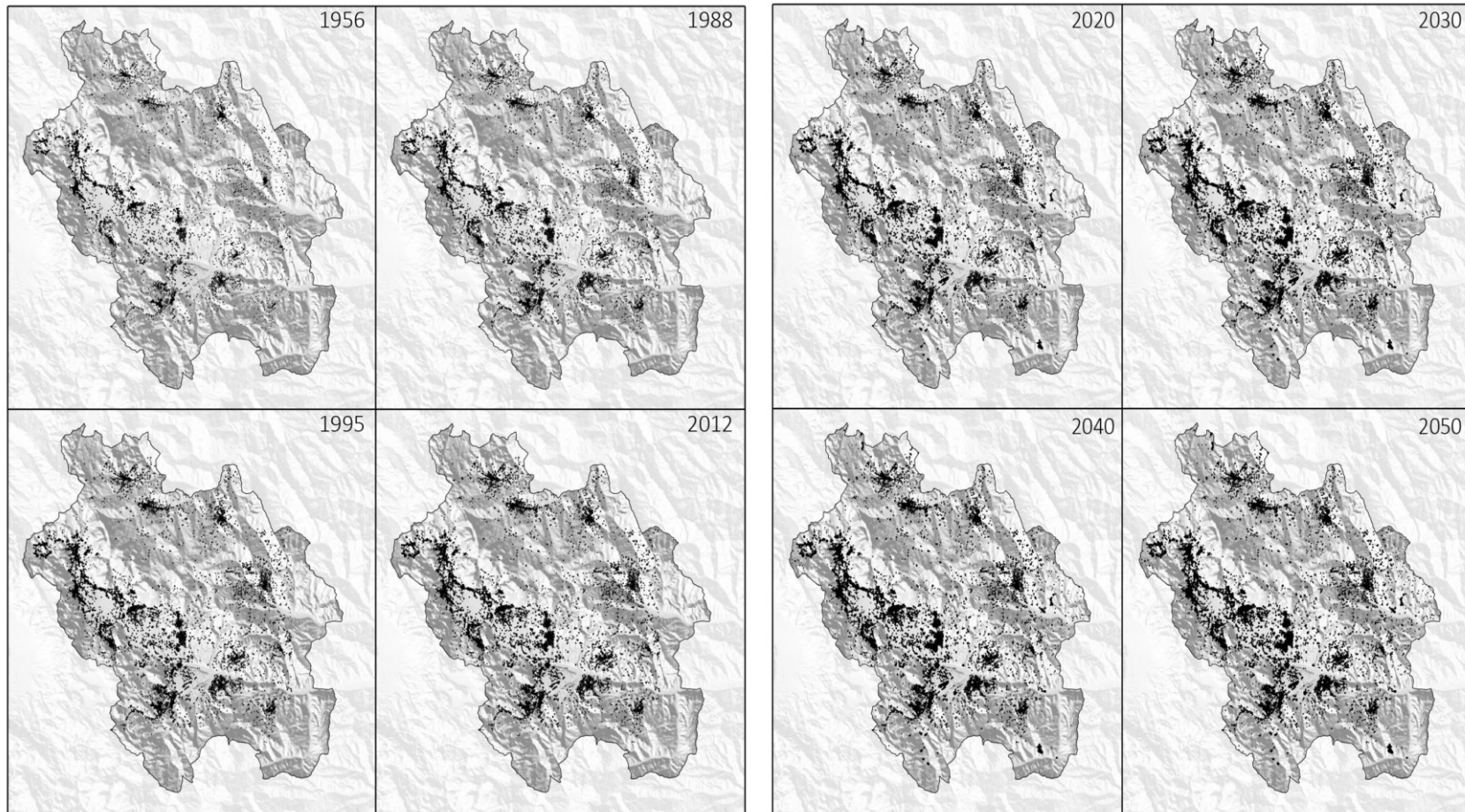
## Abstract

For more than a decade, the European Union recognizes soil as a common good and considers it as a finite



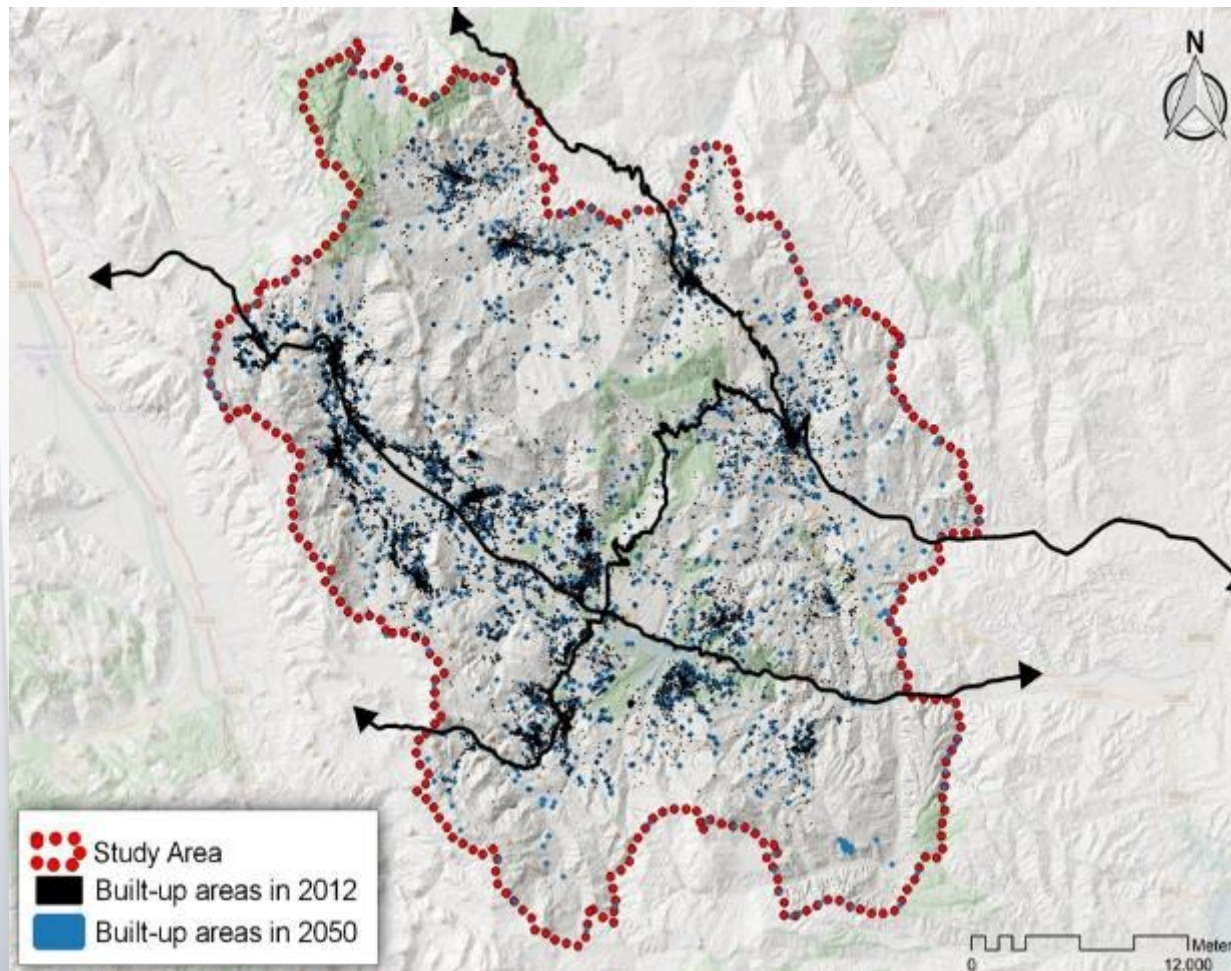
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Amato, F.; Maimone, B.A.; Martellozzo, F.; Nolè, G.; Murgante, B. (2016) **The Effects of Urban Policies on the Development of Urban Areas**. Sustainability 2016, 8, 297. doi:10.3390/su8040297

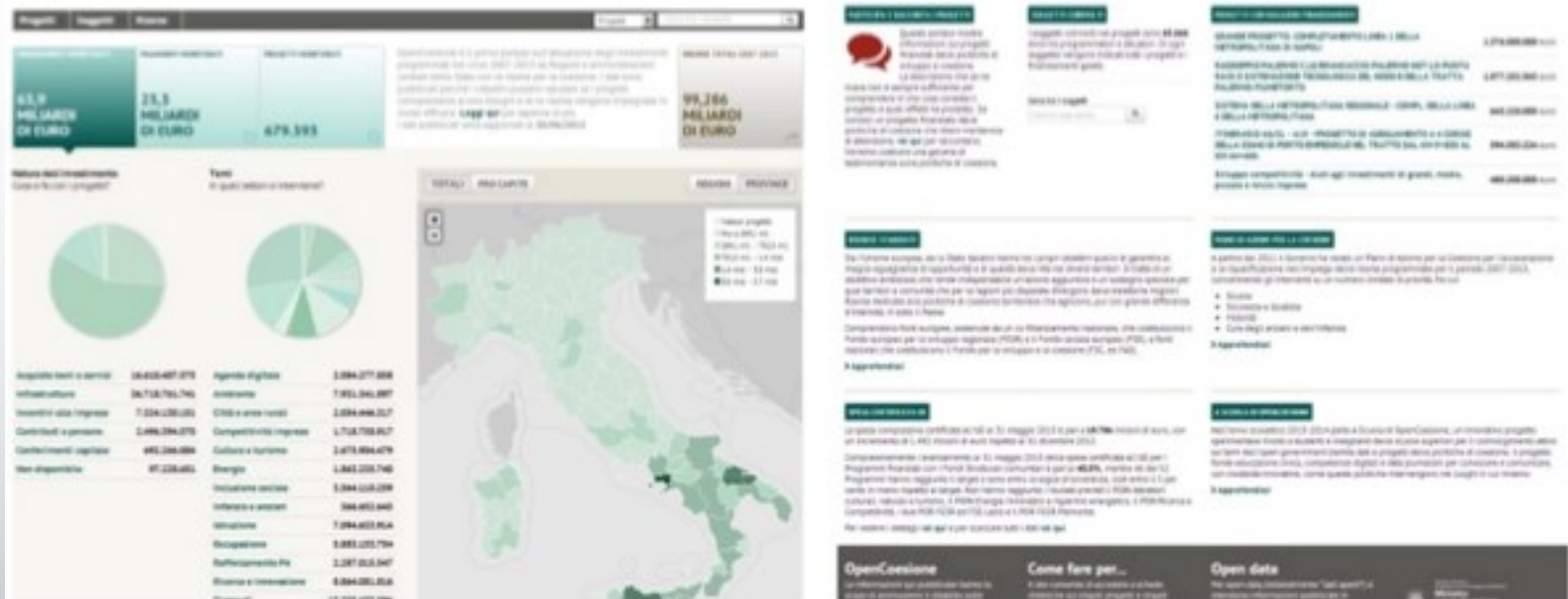


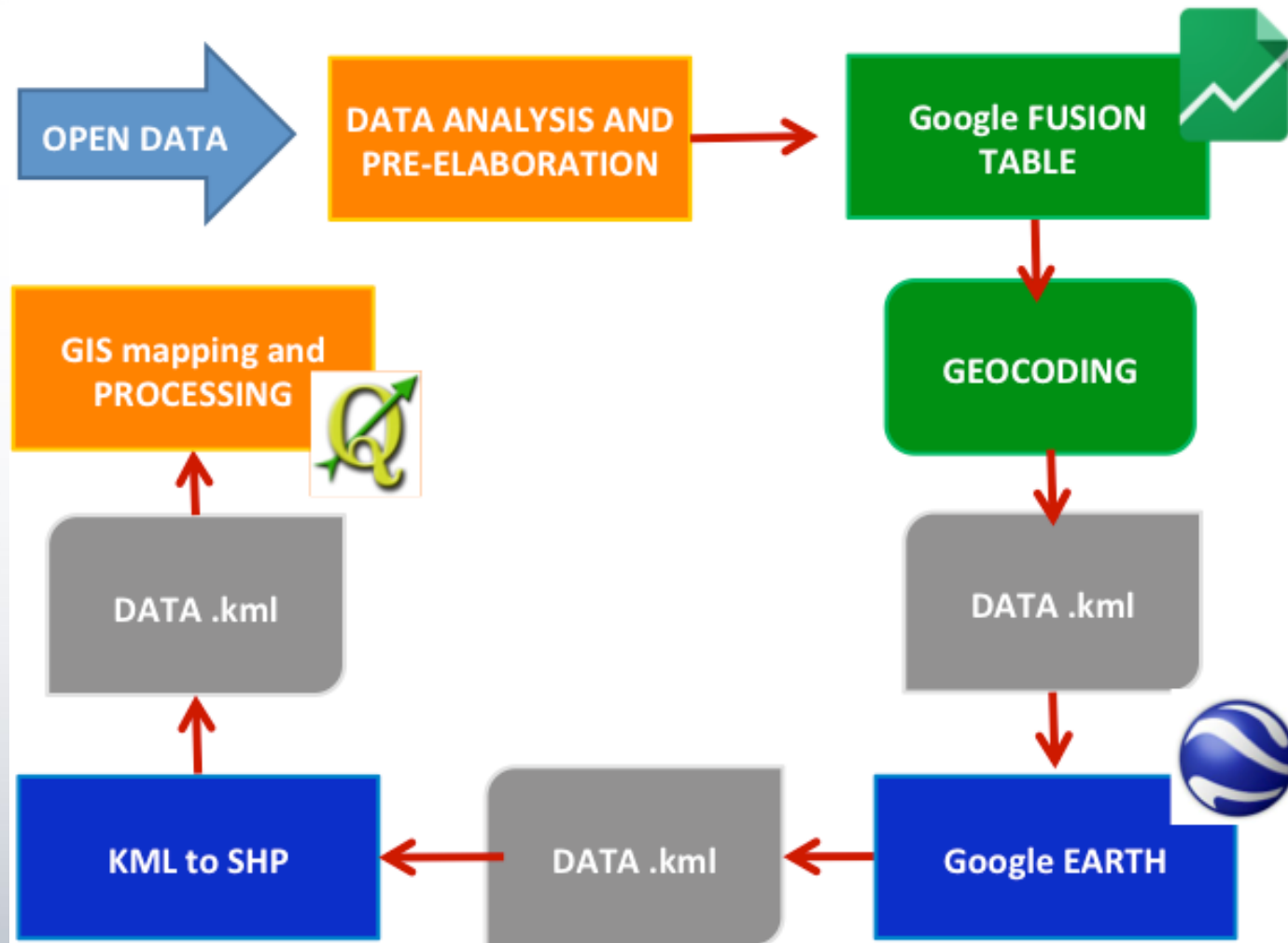


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[doi:10.3390/su8040297](https://doi.org/10.3390/su8040297)

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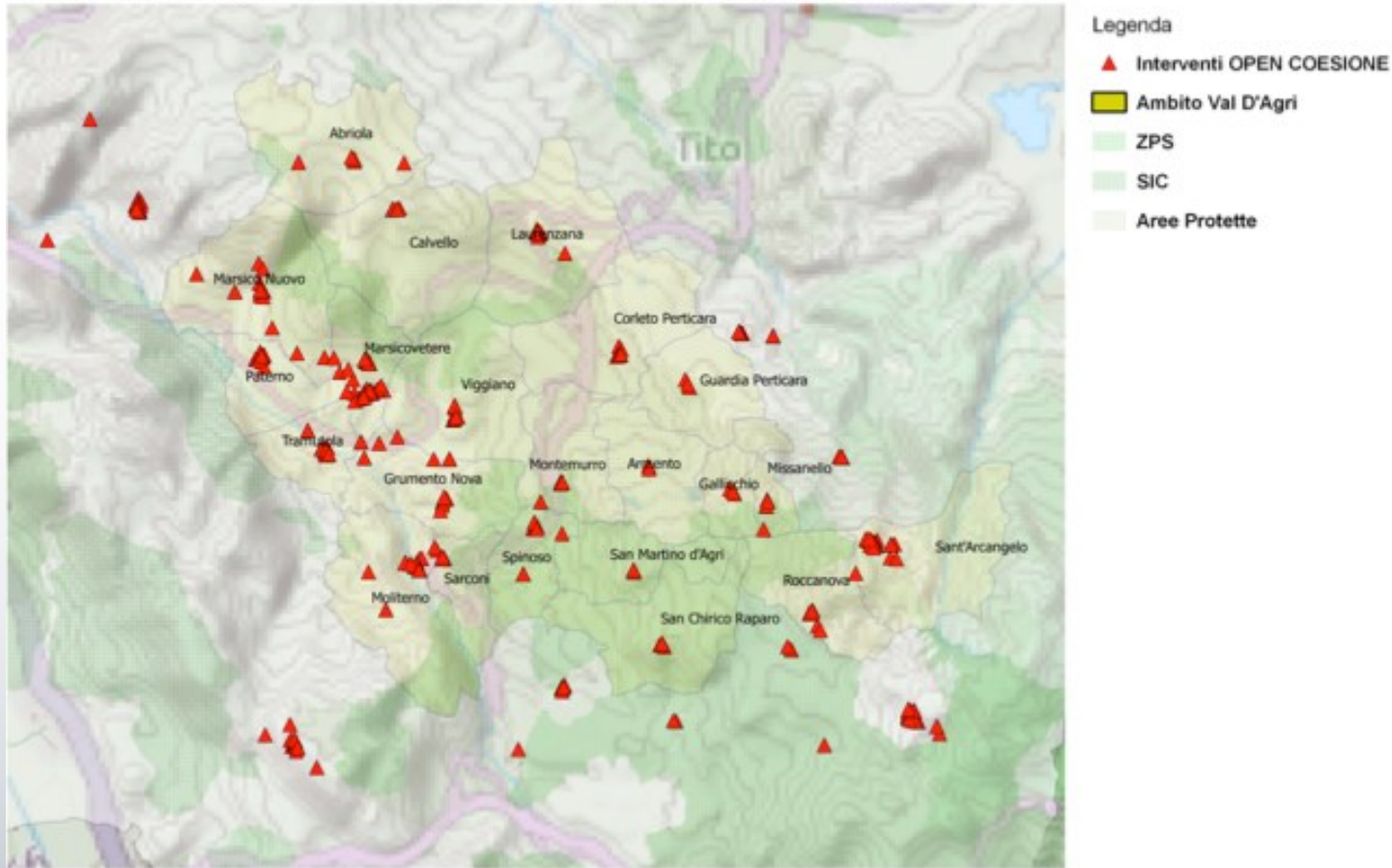


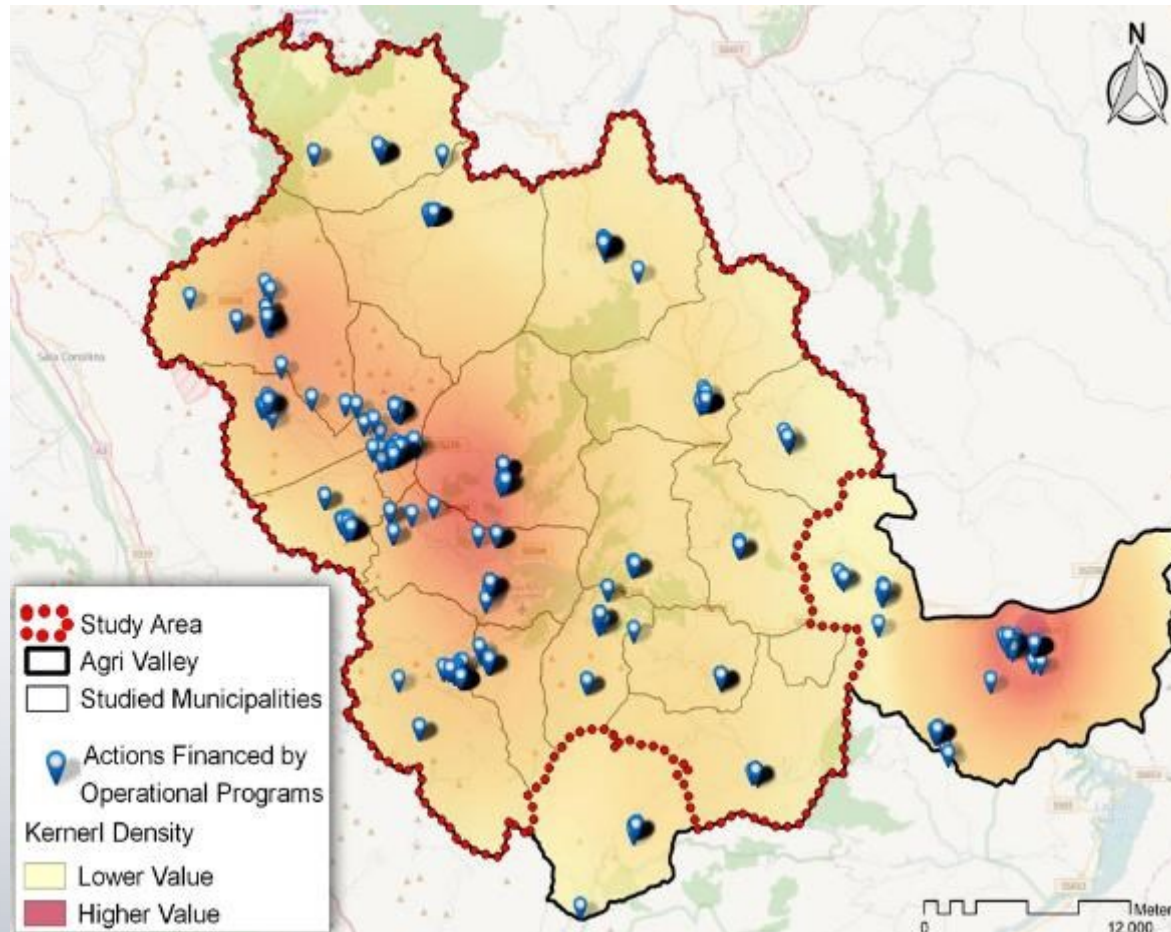






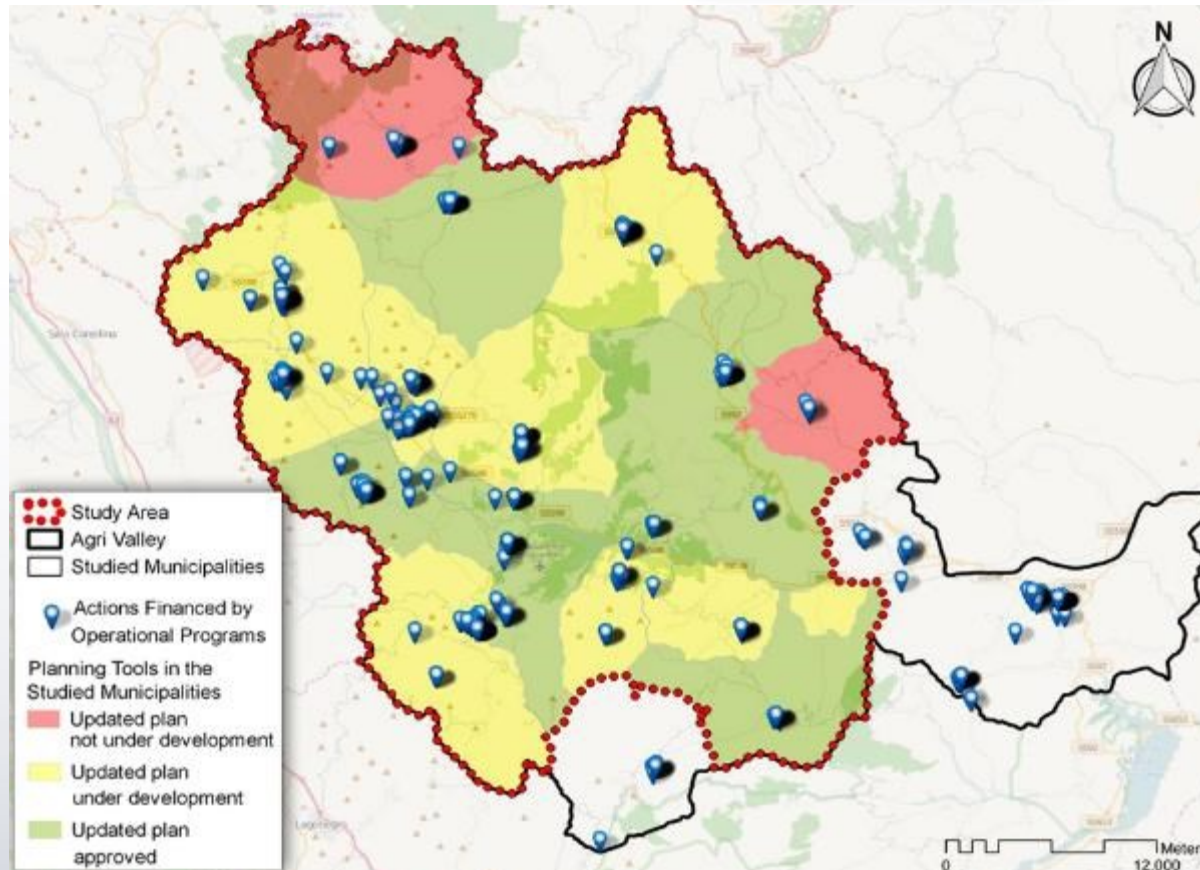
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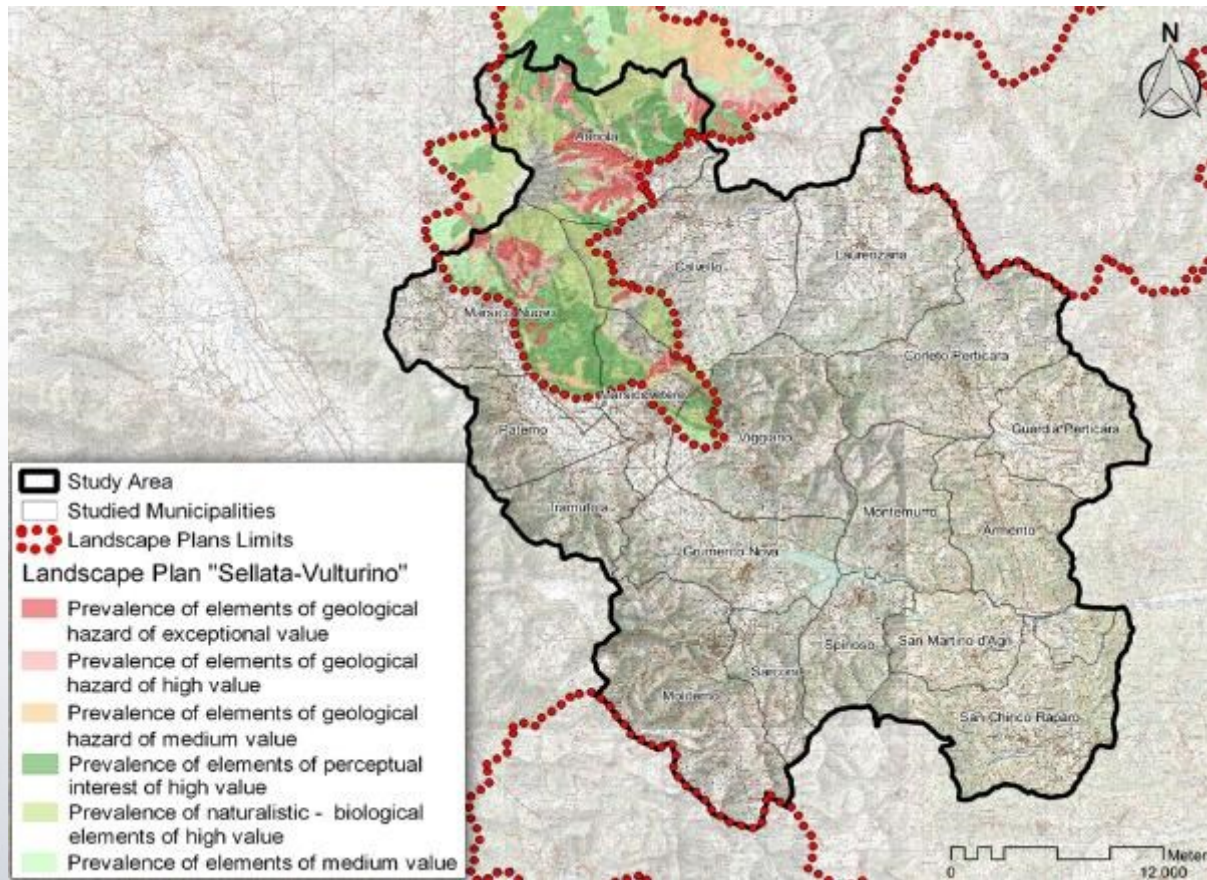


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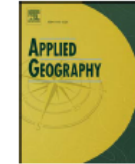
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## Modelling the impact of urban growth on agriculture and natural land in Italy to 2030

F. Martellozzo<sup>a,\*</sup>, F. Amato<sup>b</sup>, B. Murgante<sup>b</sup>, K.C. Clarke<sup>c</sup>

<sup>a</sup> University of Florence, DISEI Dep. of Economics and Management, Italy

<sup>b</sup> University of Basilicata, School of Engineering, Italy

<sup>c</sup> University of California – Santa Barbara, USA



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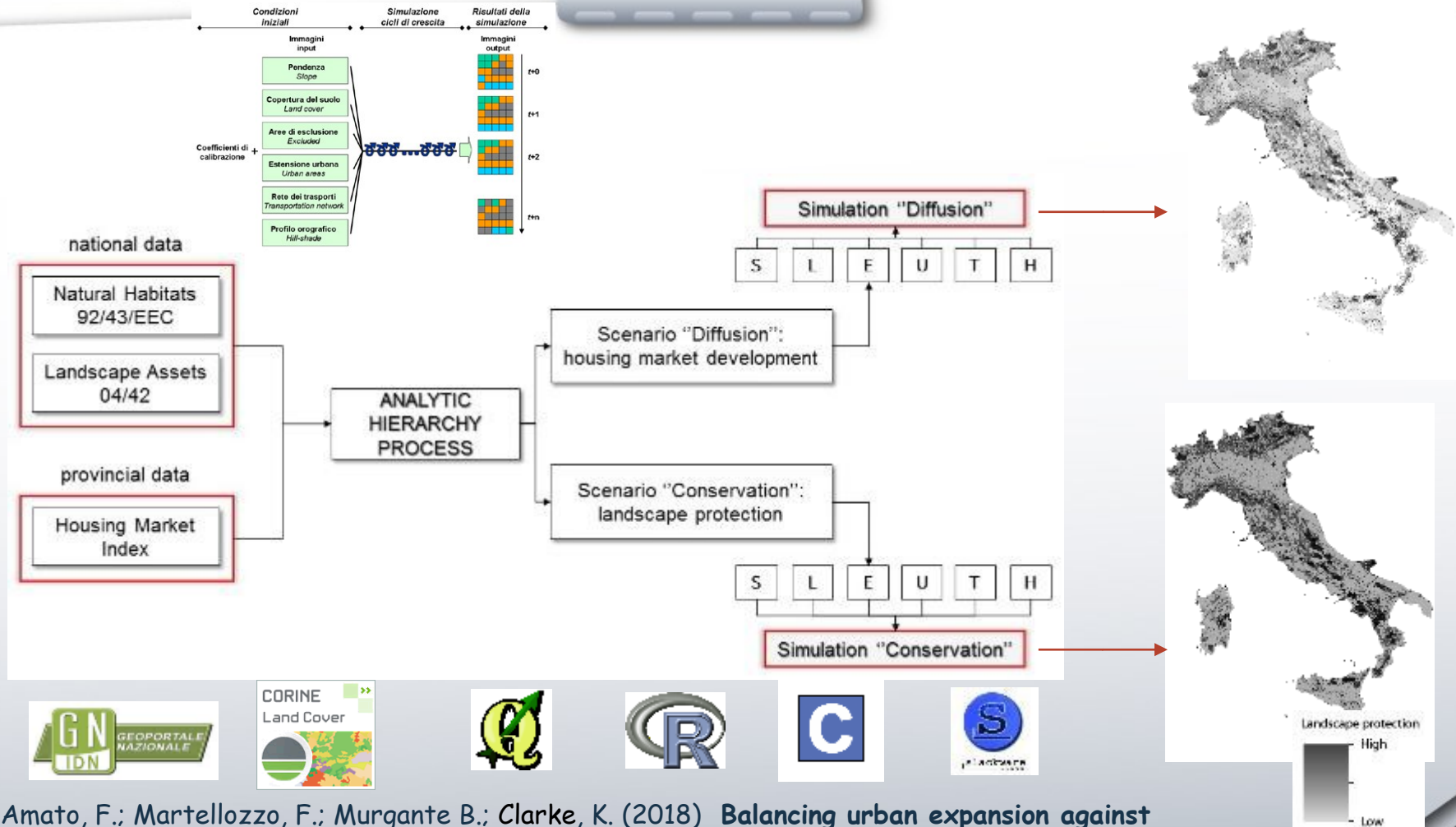
SLEUTH

Analytic hierarchy process

Sustainable development

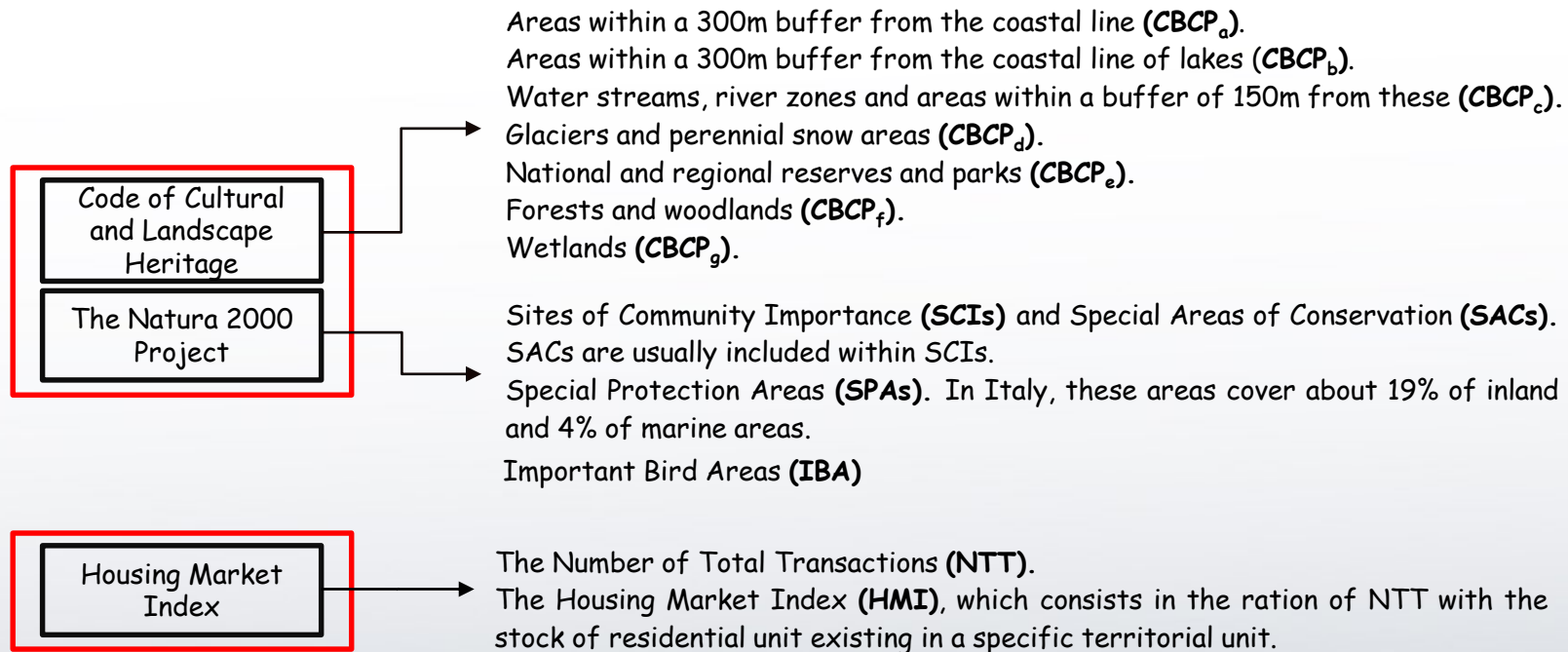
### ABSTRACT

The uncontrolled spread of towns and cities into their surrounding rural and natural land, and the consequent increasing demand for new natural resources are among the most important drivers of global climate and environmental change. This study investigated the loss of natural and agricultural land in Italy in the last decades, during which urban areas have undergone significant expansion. The study underlines the negative consequences of past uncoordinated urban and regional planning in Italy which often featured adaptive *ex-post* strategies favouring real estate market returns, rather than avoiding *ex-ante* the unsustainable threats. The aim is to show that only through a recalibration of priorities in planning, by adding policies that favour ecological conservation, it is possible to better foster sustainable land use practices. To this end, the research features a comparison of forecasts of land-use/cover changes (LUCC) corresponding to different policy-oriented scenarios, using a combination of multi criteria analysis and cellular automata modelling. In the planning literature there are many applications of land-use change modelling at the regional/local scale, however to the best of our knowledge, none does it at high resolution and at the full country scale. This sort of analysis is important for policy makers because it allows investigation of the combined relevance of local and global criteria in influencing urbanization for the future. Thus it couples locally relevant findings with a comprehensive vision of the phenomenon at a national scale. We conclude by discussing some critical socio-economic implications of the modelled scenarios in order to provide policy makers with useful tools and information to develop resilient and sustainable planning strategies.



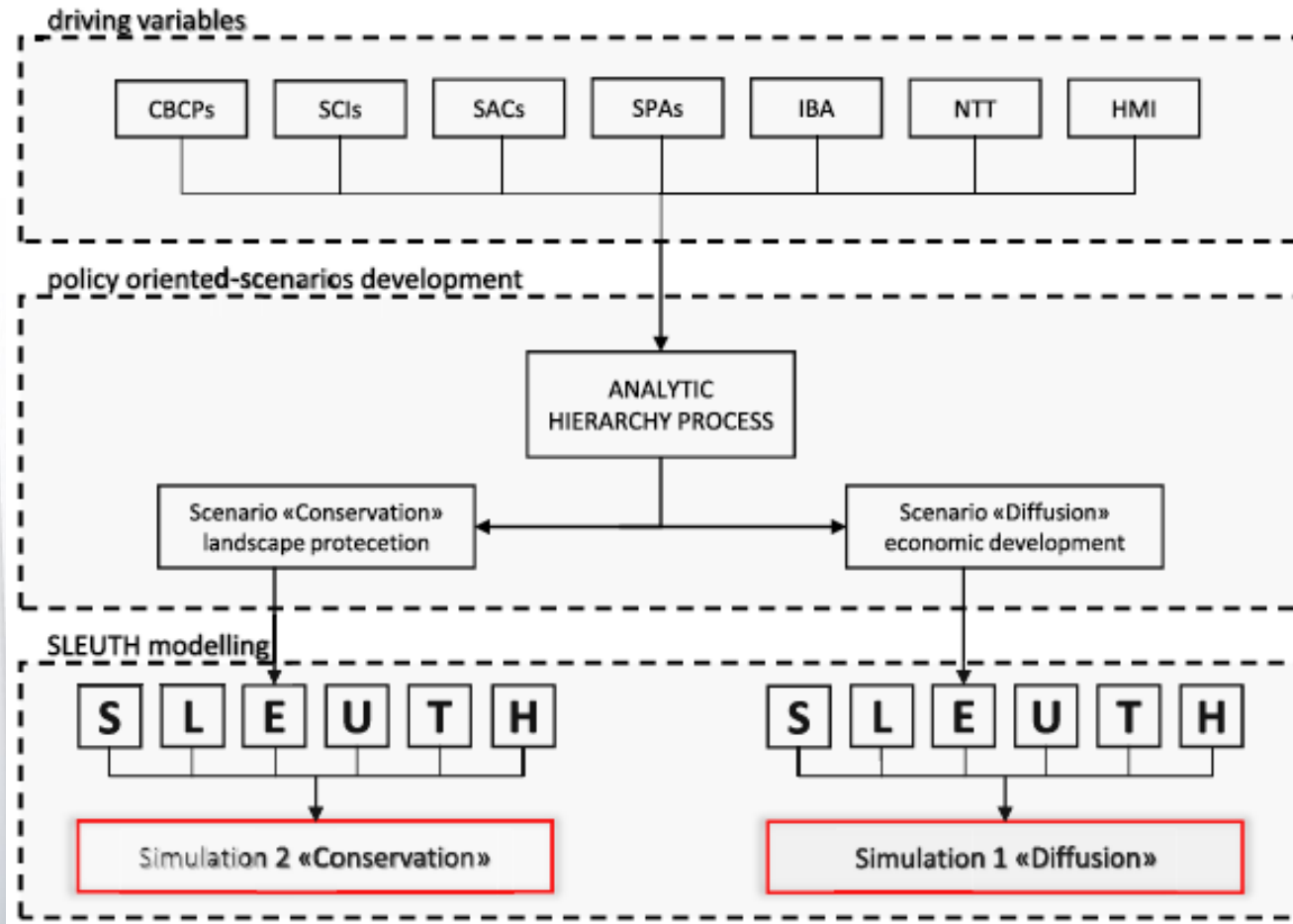
Amato, F.; Martellozzo, F.; Murgante B.; Clarke, K. (2018) **Balancing urban expansion against agriculture and natural land loss: Scenario-based Modelling of urbanization and ecological losses in Italy to 2030** *Applied Geography* 91, pp. 156-167 DOI: 10.1016/j.apgeog.2017.12.004





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# Spatial Information in supporting environmental planning and disaster management



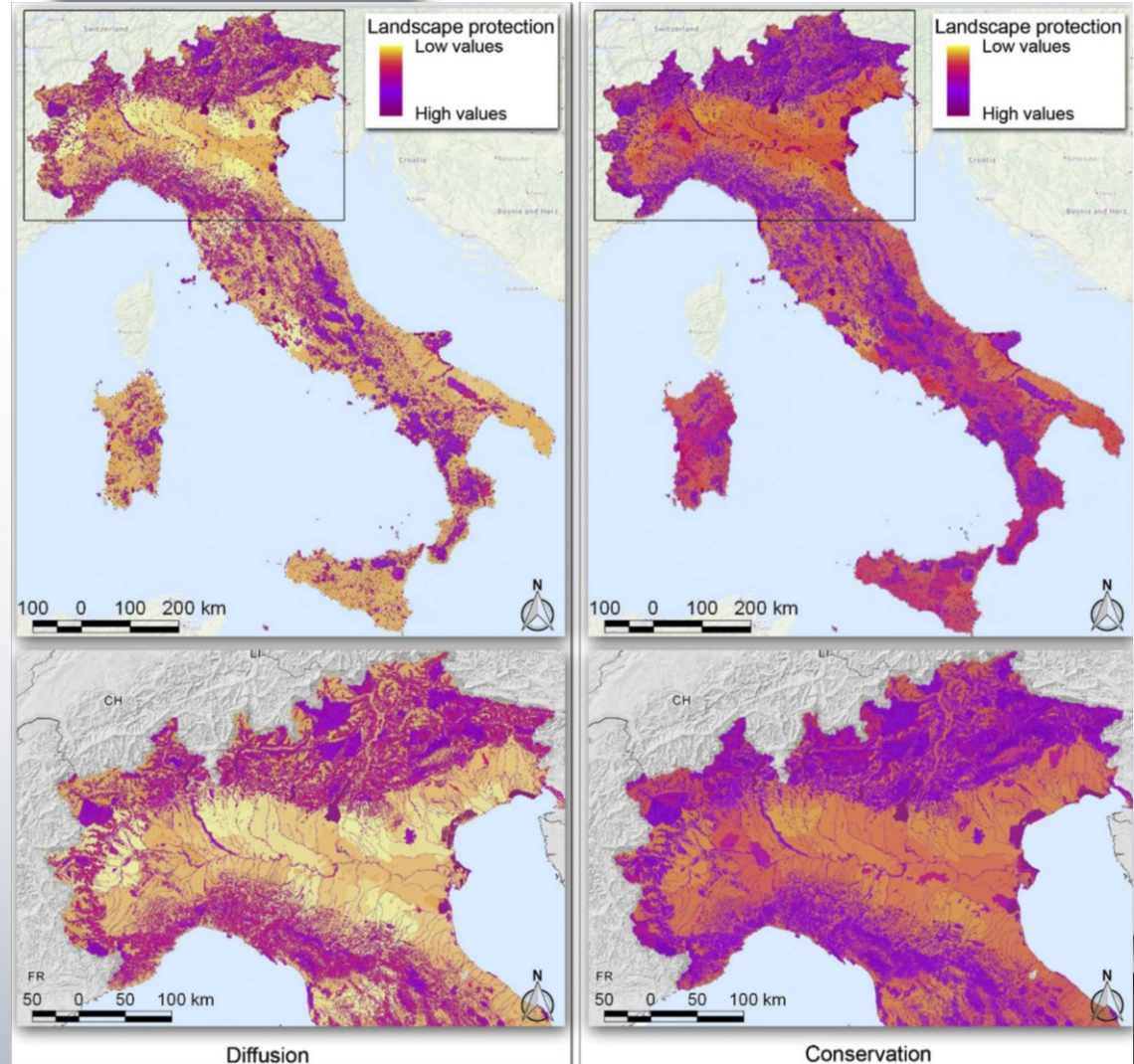
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# Spatial Information in supporting environmental planning and disaster management

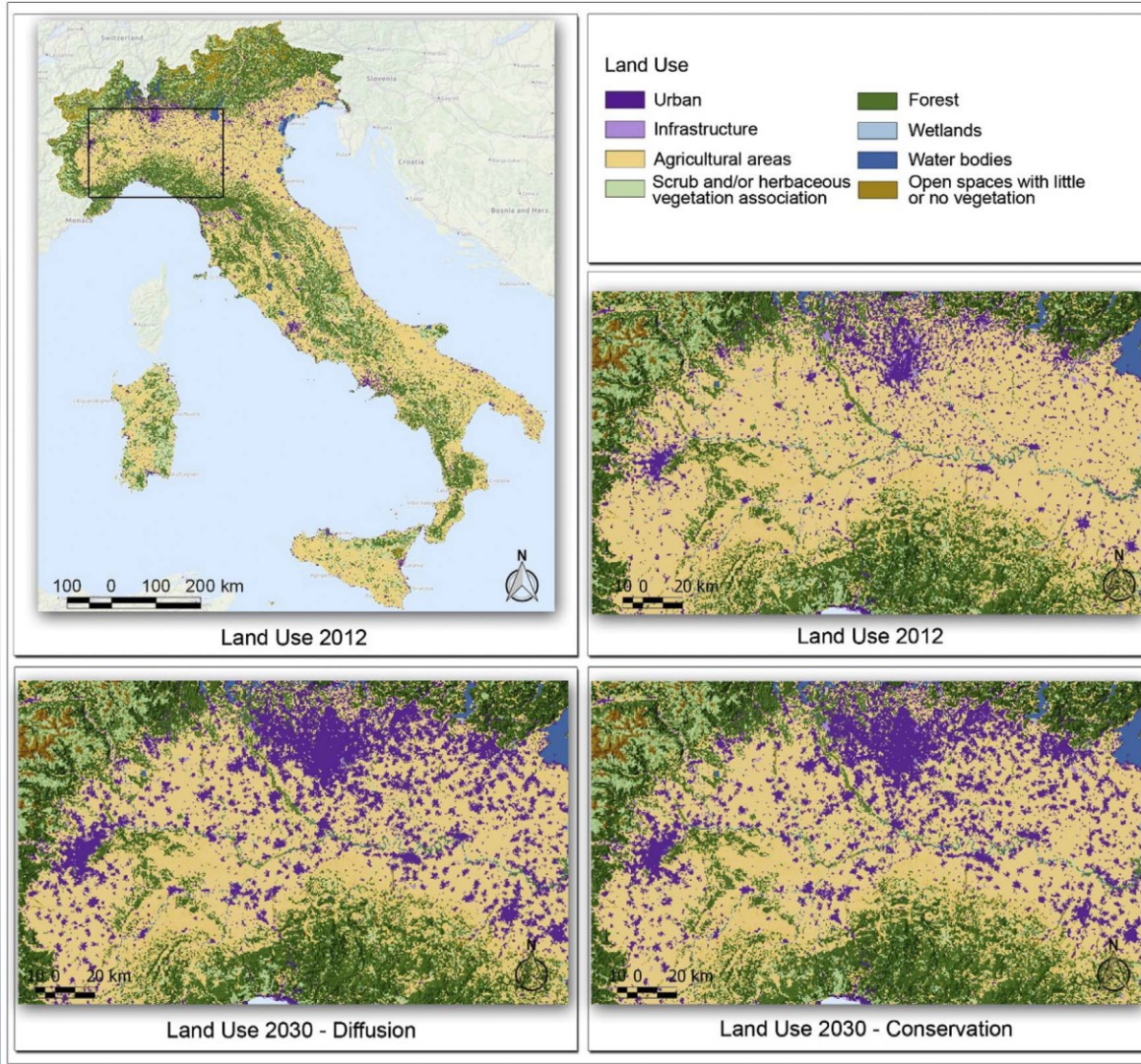
	Scenario <i>conservation</i>	Scenario <i>BAU/diffusion</i>
CBCPa	0,112	0,085
CBCPb	0,112	0,085
CBCPc	0,112	0,085
CBCPd	0,112	0,085
CBCPe	0,112	0,085
CBCPf	0,112	0,085
CBCPg	0,112	0,085
SCIs	0,047	0,033
SPAs	0,047	0,033
IBA	0,031	0,022
HMI	0,02	0,32

Criteria's weights resulting from the AHP and used for the scenario *conservation* and for the scenario *BAU/diffusion*.

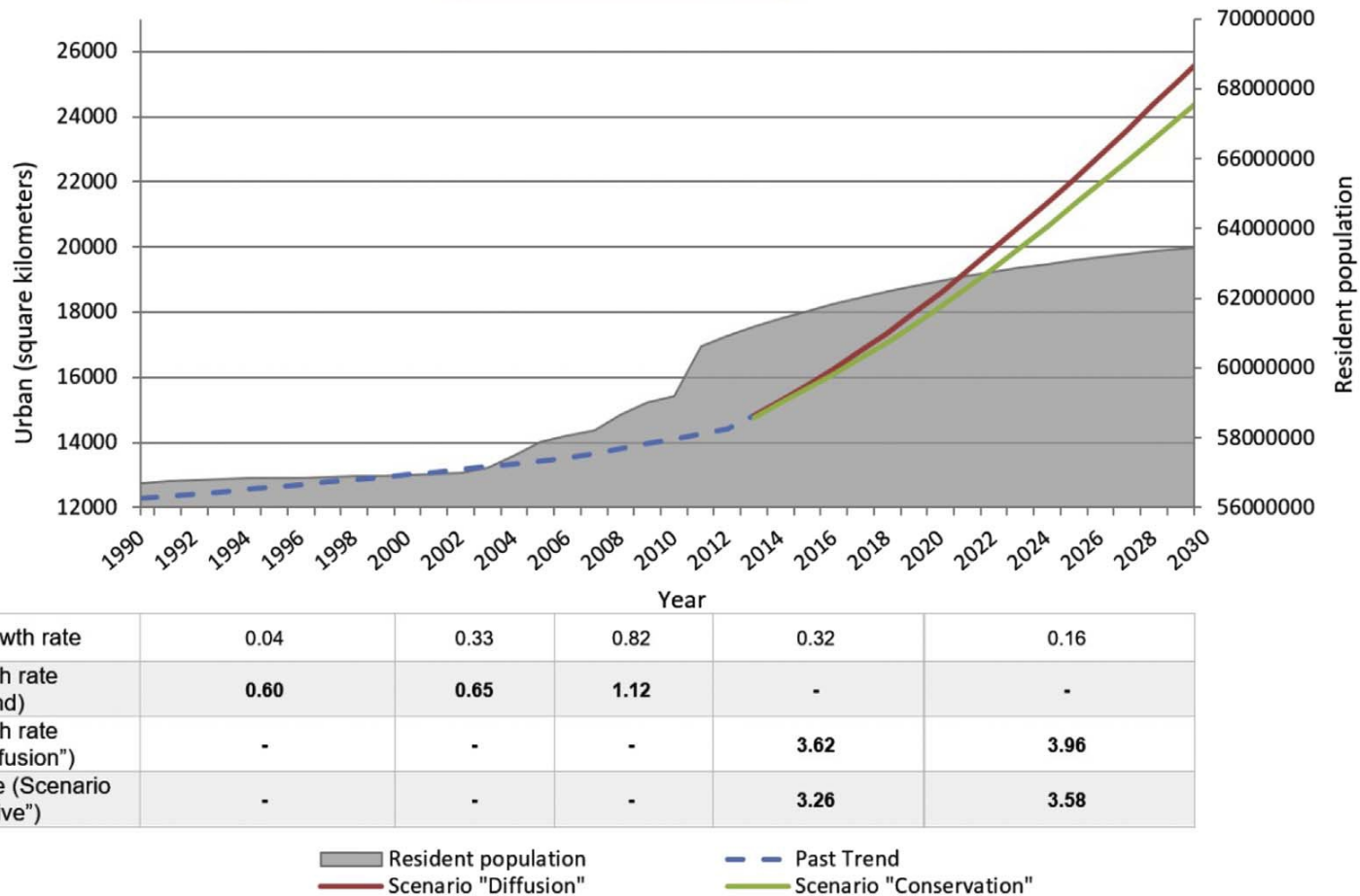
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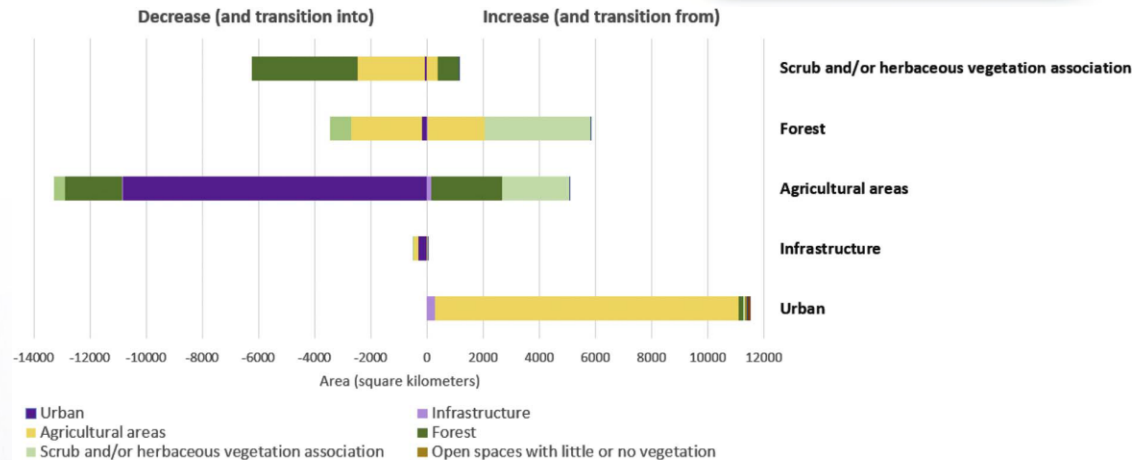




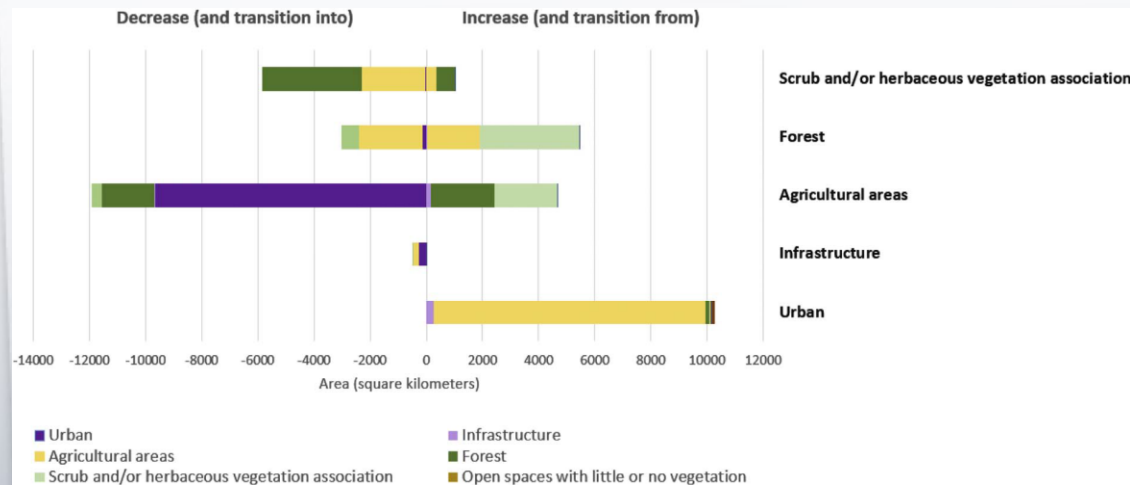
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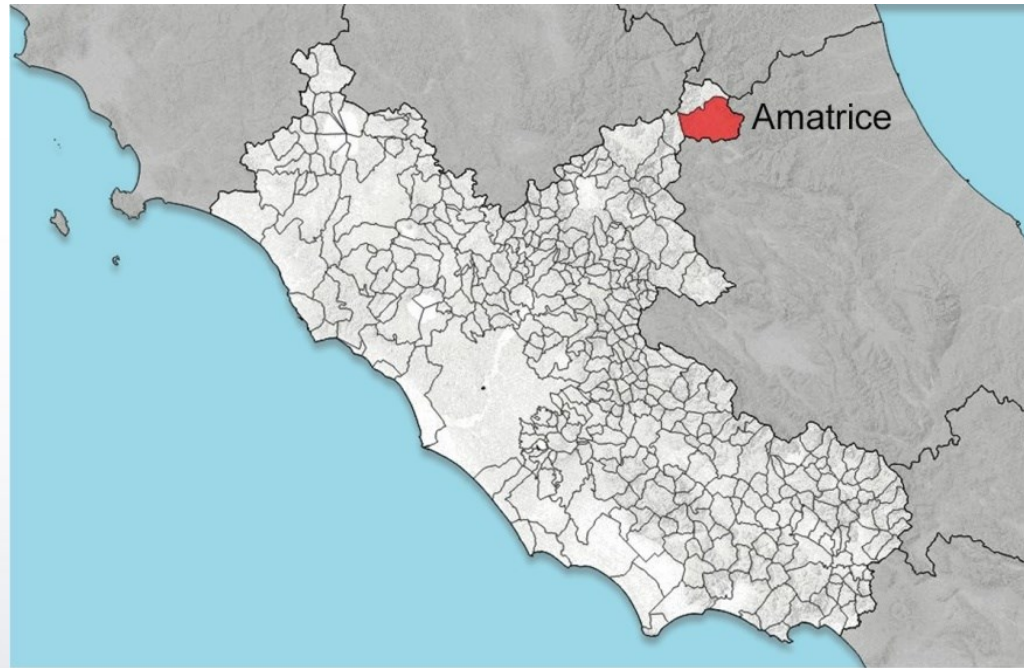
LUCC dynamics between 2012 and 2030 according to the Diffusion scenario



LUCC dynamics between 2012 and 2030 according to the Conservation scenario

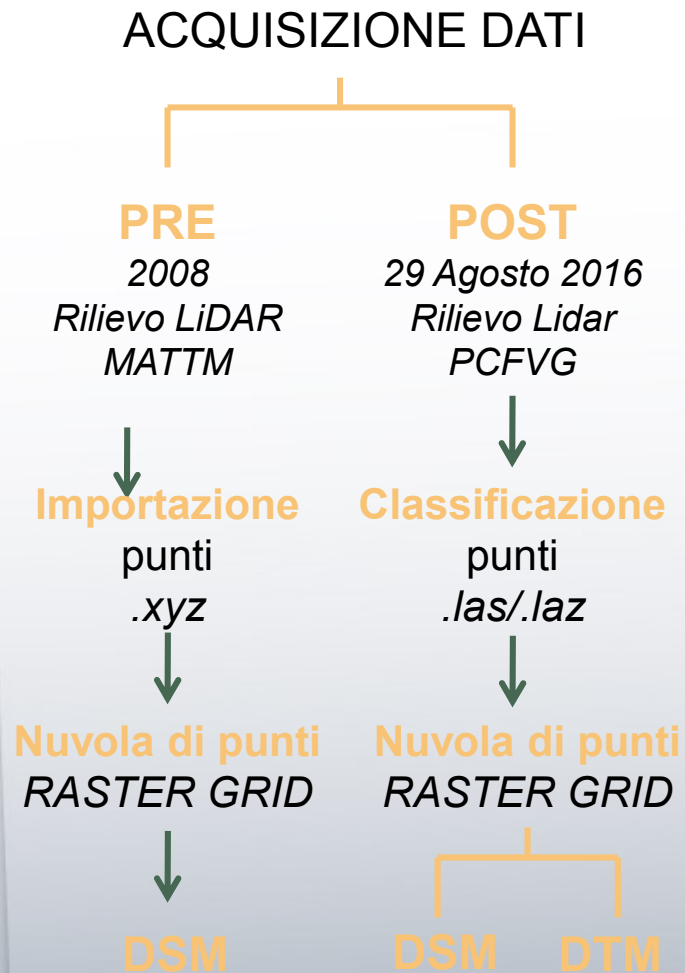
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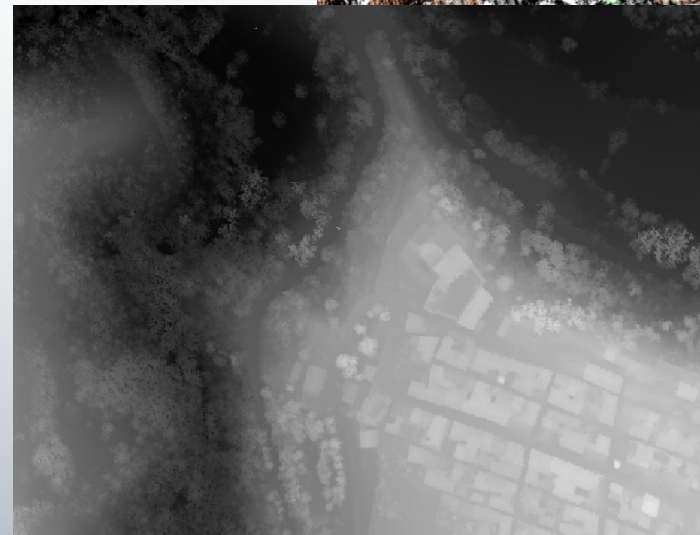
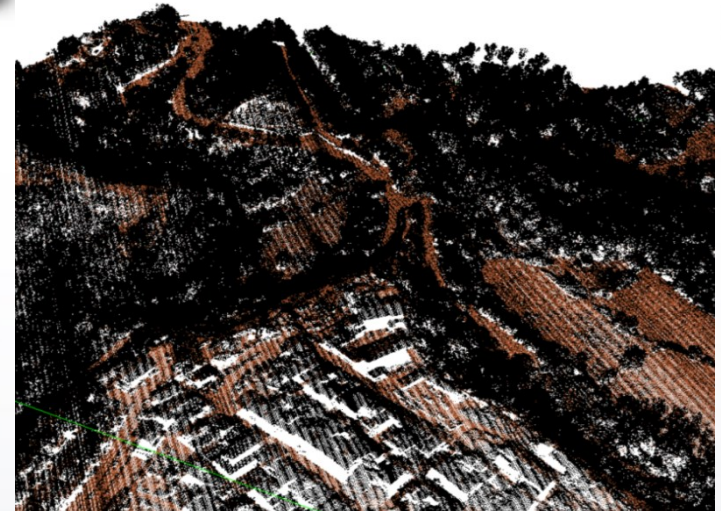


Saganeiti L., Amato, F.; Nolè, G.; Potleca M., Vona M.; Murgante, B., **"Change Detection and Classification of Seismic Damage with LiDAR and RADAR Surveys in Supporting Emergency Planning. The Case of Amatrice"** Lecture Notes in Computer Science Volume 10407 pp 722-731, Springer Verlag, Berlin, DOI: 10.1007/978-3-319-62401-3\_53

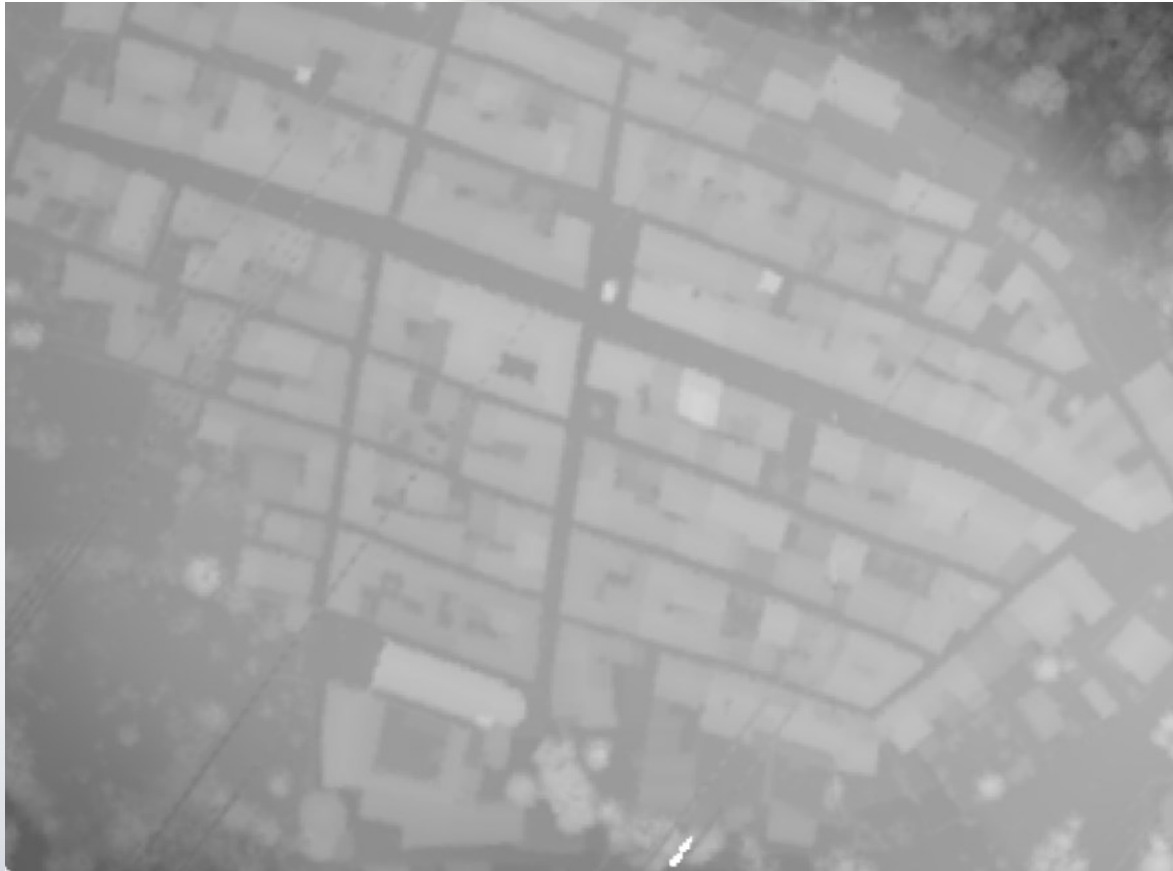
Dataset LiDAR DSM e DTM



Nuvola di punti  
POST sisma



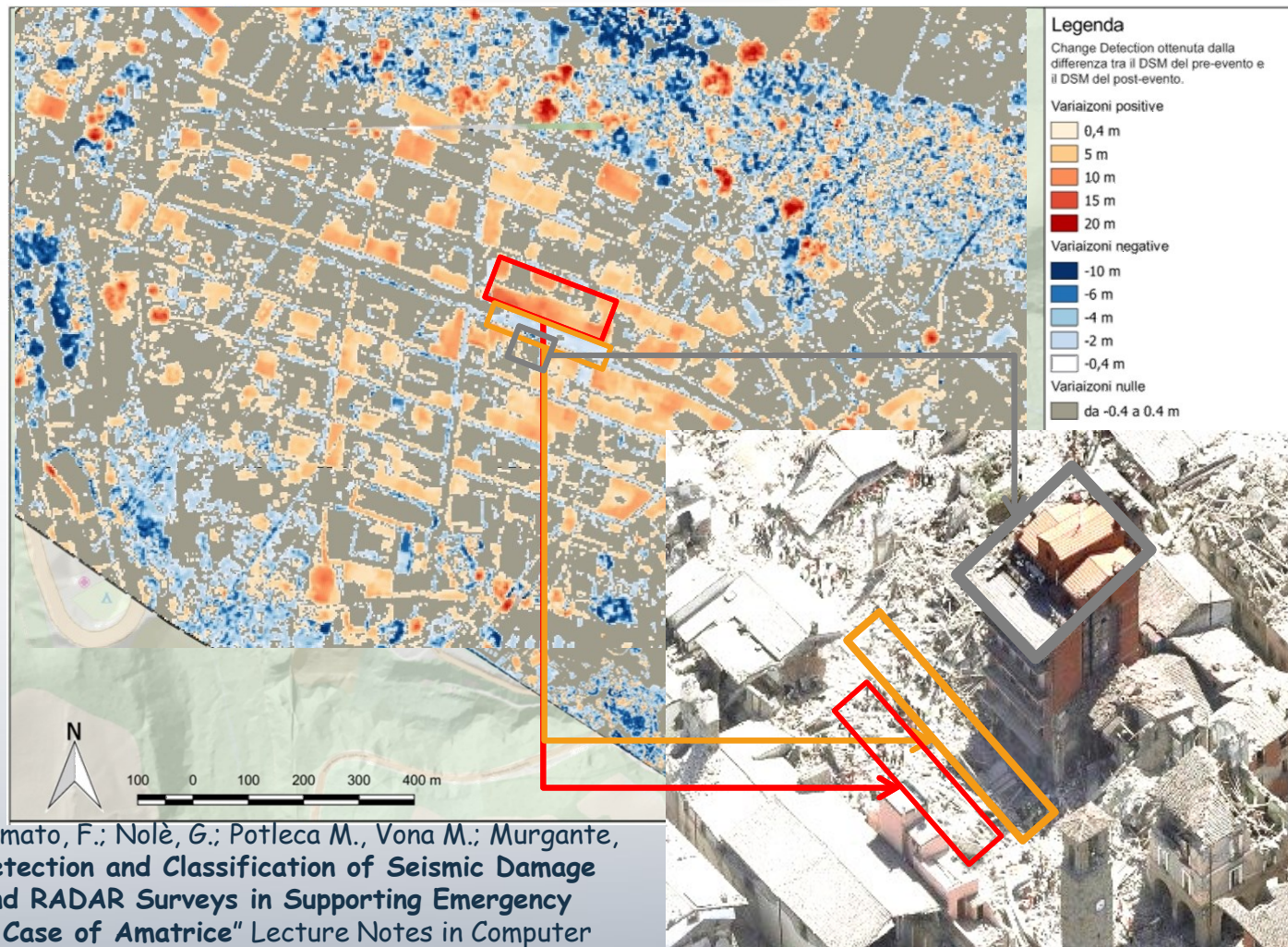
DSM POST sisma



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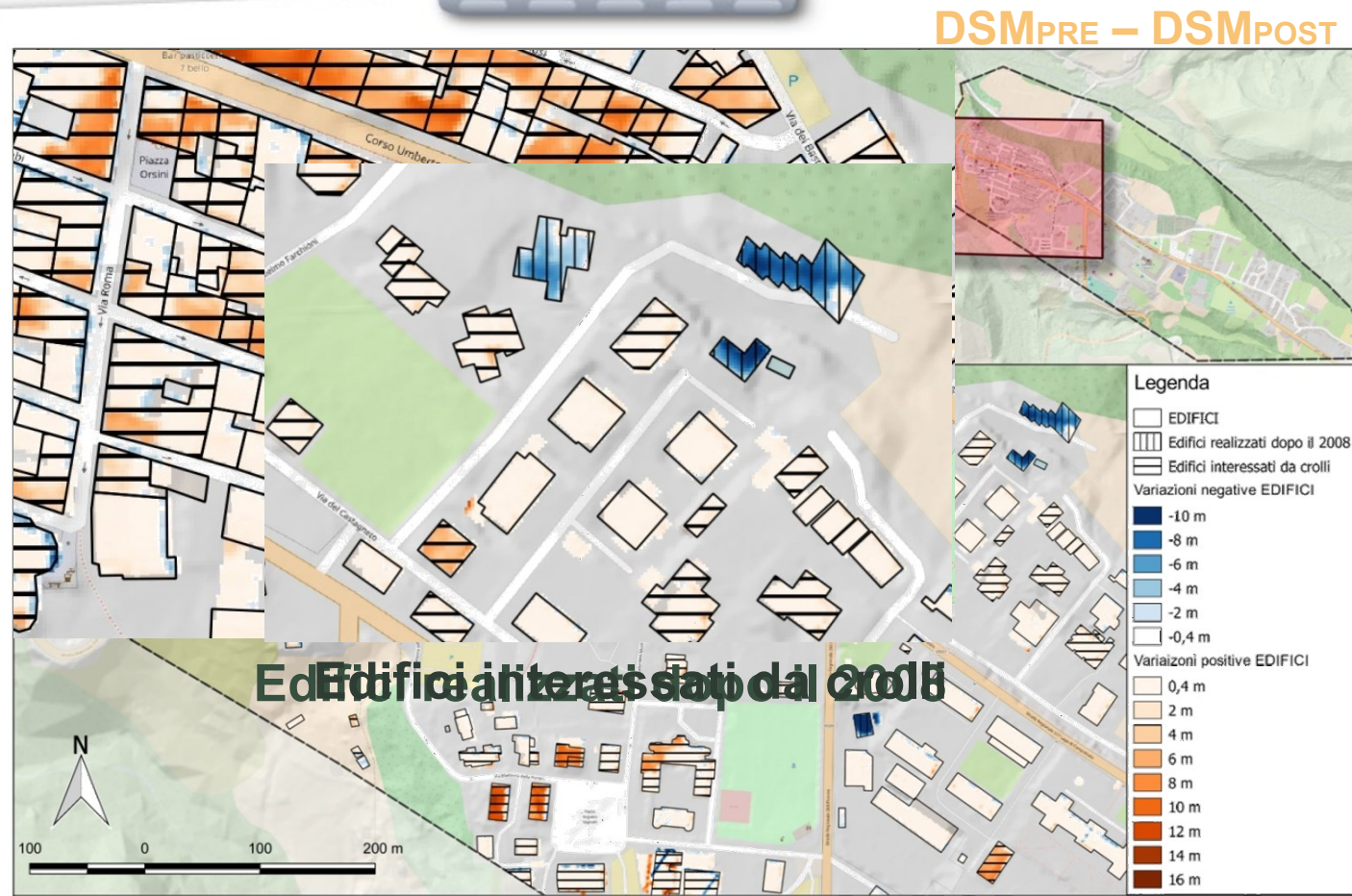


## DSM<sub>PRE</sub> – DSM<sub>POST</sub>



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Classificazione **non esaustiva**

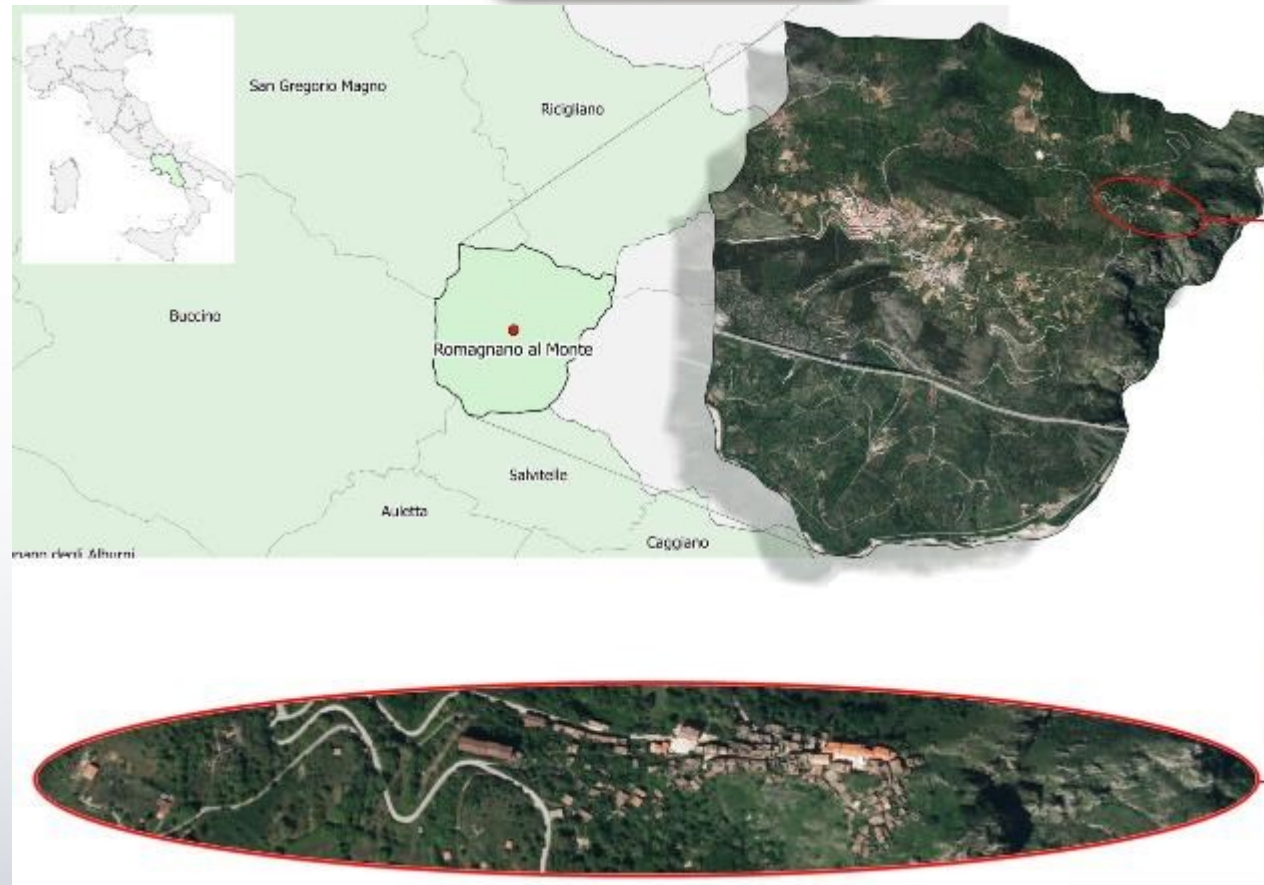
Può indurre in **errori di valutazione**

Affiancata sempre da un **rilievo in loco**

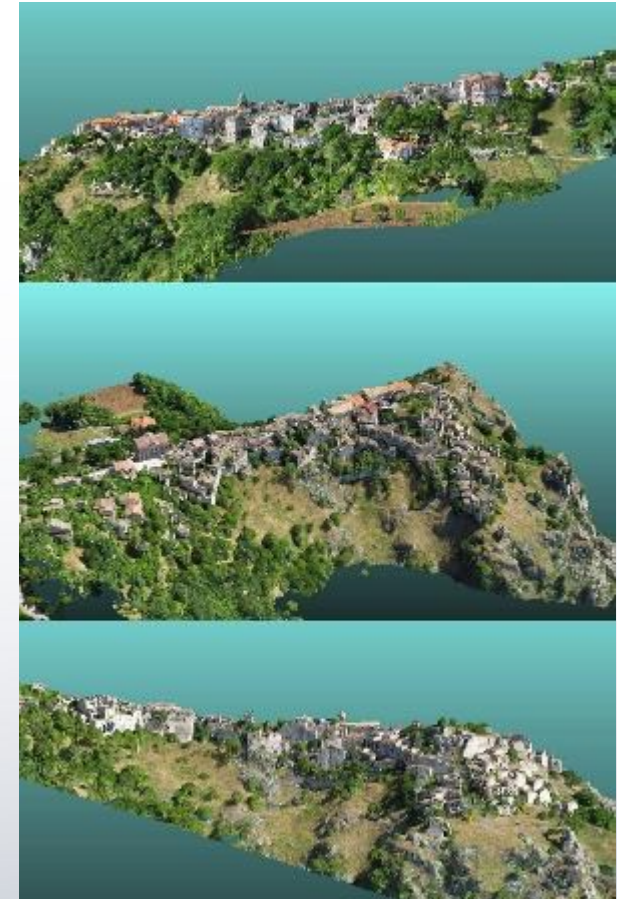
$\Delta_h=0$  —————> Classe inferiore alla 4?







Vona M., Cascini G., Mastroberti M., Murgante B., Nolè G., (2017) **Characterization of URM buildings and evaluation of damages in a historical center for the seismic risk mitigation and emergency management**, International Journal of Disaster Risk Reduction, Volume 24, Pages 251-263, ISSN 2212-4209, <http://dx.doi.org/10.1016/j.ijdr.2017.05.008>



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## CASO 1 – Crollo totale nel solaio di copertura

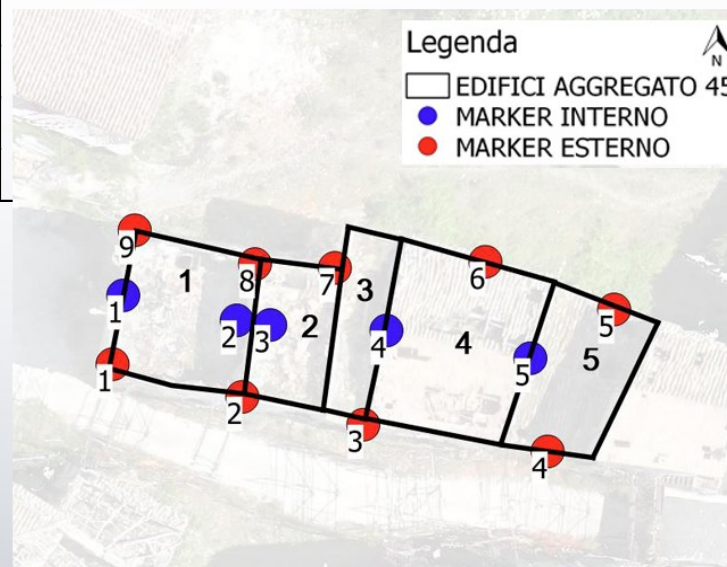
Case 1. Geometric characteristics of buildings.

Building	Surface (m) <sup>2</sup>	Perimeter (m)	Average thickness of the masonry walls (m)
1	34.86	21.77	0.42
2	25.91	23.95	
3	17.48	17.21	
4	22.03	19.00	

Vona M., Cascini G., Mastroberti M., Murgante B., Nolè G., (2017) **Characterization of URM buildings and evaluation of damages in a historical center for the seismic risk mitigation and emergency management**, International Journal of Disaster Risk Reduction, Volume 24, Pages 251-263, ISSN 2212-4209, <http://dx.doi.org/10.1016/j.ijdr.2017.05.008>



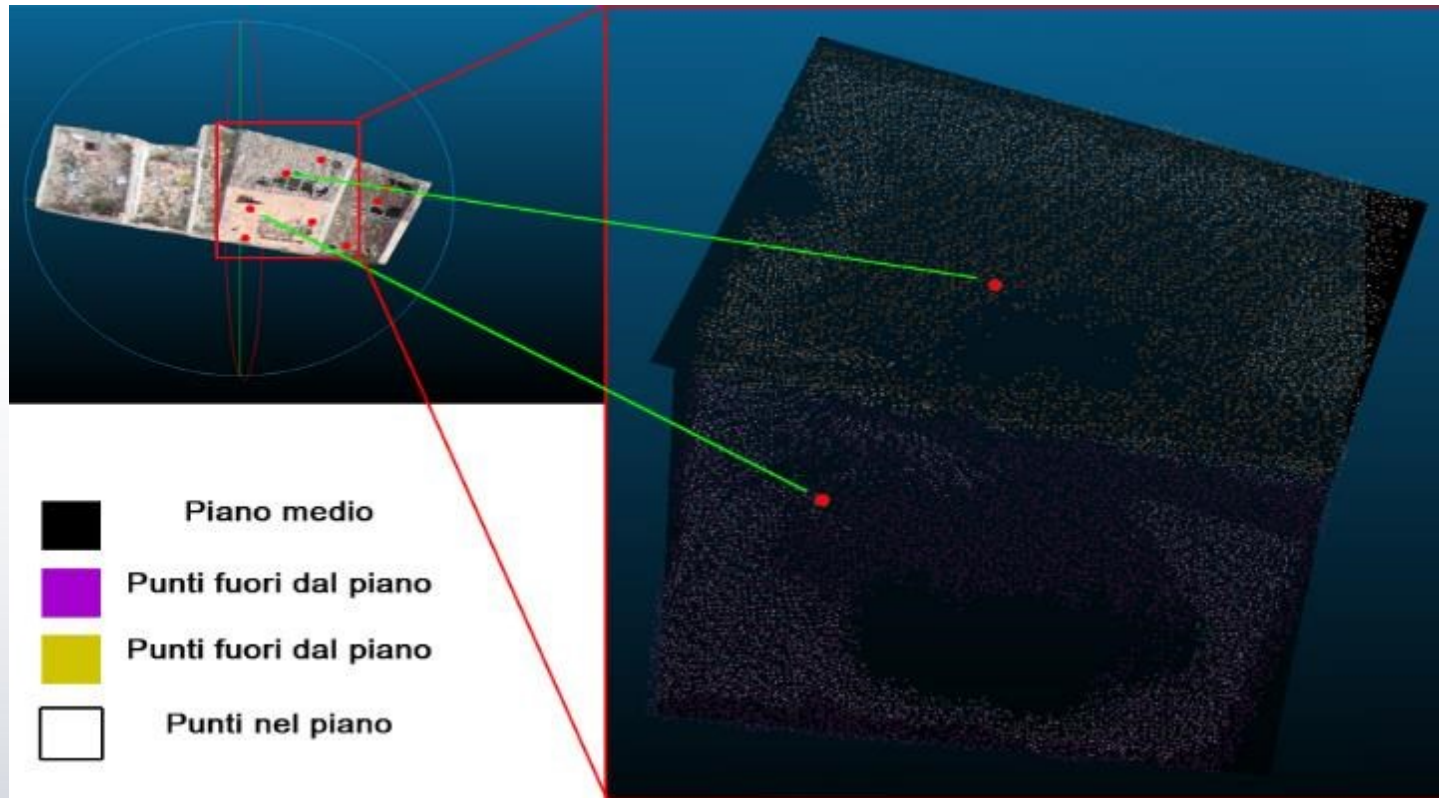
MARKER EST	$\Delta h$ (m)	MARKER INT	$\Delta h$ (m)
1	6.20	1	0.44
2	9.15	2	1.85
3	6.85	3	1.60
4	4.25	4	1.90
5	7.65	5	3.60
6	10.05		
7	8.20		
8	9.60		
9	6.80		



### CASO 2 – Crollo parziale nel solaio di copertura

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## CASO 2 – Crollo parziale nel solaio di copertura



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EUROGI Members Meeting  
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for Industrial Revolution 4.0 and Society"  
April 26th, Fisciano, Università di Salerno,  
Dipartimento di Informatica



**Thank you for your attention**

***Beniamino Murgante***

*School of Engineering, University of Basilicata*

*beniamino.murgante@unibas.it*

*<http://oldwww.unibas.it/utenti/murgante/Benny.html>*

*<https://unibas-it.academia.edu/BeniaminoMurgante>*

*[https://www.researchgate.net/profile/Beniamino\\_Murgante](https://www.researchgate.net/profile/Beniamino_Murgante)*

