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There are a number of different future-city visions being developed around the world at the moment: one of them is Smart Cities: ICT and big data availability may contribute to better understand and plan the city, improving efficiency, equity and quality of life. But these visions of utopia need an urgent reality check: this is one of the future challenges that Smart Cities have to face.

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EXTREME WEATHER EVENTS CAUSED BY CLIMATE CHANGE

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Cover Image: Wind travels across Lake Washington, buffeting the 520 floating bridge as the storm grows in strength. (Steve Ringman / The Seattle Times).

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EDITORIAL PREFACE:

EXTREME WEATHER EVENTS CAUSED BY CLIMATE CHANGE

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In the 21st century the world is facing some major challenges as cities are pressed to confront climate change, massive pollution, dwindling natural resources, excessive urban population, traffic congestion, as well as social and political unrest. Of these, climate change, the single most global threat to the survival of future generations on the planet, is happening as a result of global warming attributed to carbon emissions in the post-industrial-revolution world. Many skeptics believe global warming is taking place as one of several natural geological cycles that caused similar climate changes in the past. However, the accelerated rise in the temperature of earth's atmosphere during the last several decades demonstrates the fact that it is something more than that. There must have been man-made intervention resulting in the rapid augmentation of the carbon footprint resulting in global warming. This is the present general scientific consensus. It is indeed a new geological era, but this time, according to the majority of scientists, it is indeed caused by humans.

The awful famines caused by droughts, heat waves, frequent hurricanes and floods, erratic changes in weather patterns, and the rise of sea level everywhere today may be in part due to the assault on the environment during the "Anthropocene," the new geological era when human activities -- mainly industrialization -- are destroying the prospects for decent survival of humans and other species on the planet. These adverse natural phenomena caused by human intervention will continue with enormous consequences for future generations, unless curtailed now.

While climate change is a worldwide problem impacting our lives in both rural and urban settings, cities are particularly vulnerable in that they are immovable where most of the world population live. In 2007, more than half of world's 6.5 billion inhabitants lived in cities, marking for the first time in human history that more people lived in urban rather than rural areas. This is a dramatic shift from 1950, when less than one-third of the world's 2.5 billion people lived in cities. It is projected by the Population Division of the United Nations' Development and Social Affairs that by 2050 nearly 80 per cent of the world's 9 billion people will live in massive urban fabrics. It is expected that this trend may continue beyond this time frame. Consider also the fact that in 1950, New York and Tokyo were the only two megacities with 10 million or more populations. Today there are at least 22 megacities, and by 2025, there will be an estimated 30 or more. Most of these will be in developing countries with constrained physical and economic resources. Some critical attributes of cities are their infrastructure as bridges, subway systems, water supply, roads, and energy systems, buildings, healthcare, food distribution, amenities of urban life, the historic sense of place, and deep-rootedness of residents. These strengths of place can, however, become liabilities if the local ecosystems are unable to adapt to the climate-induced changes. Climate change poses serious threats to urban infrastructure, quality of life, and entire urban systems. All countries, poor and rich, will increasingly be affected by uncharacteristic climate events and trends.

Historically, cities were located near rivers, oceans and waterfronts for transportation and connectivity purposes. This natural geographic advantage has now become vulnerability for these cities as sea levels rise and wind storms increase in severity and frequency. Many major cities of the world, both in developed and developing countries, are at risk from rising sea level and coastal surges caused by global warming. For example, subways, bridges, sewers, and other major infrastructures in London, New York, and Paris are more than 100 years old. Building comparable infrastructure in newly developed cities like Jakarta, Bangkok, Shanghai, Karachi, Rio de Janeiro, Mumbai, Dubai, etc. to account for possible sea level increases adds more complexity to the existing environment. A more difficult issue yet is that some cities and their national governments will consider the need for relocation of inhabitants and potential abandonment of key infrastructure and areas prone to flooding. This would represent one of the largest losses of land value and infrastructure and the largest transfer of economic resources in human history.

There are two basic approaches to cope with the challenge posed by climate change: adaptation and mitigation. There is a significant distinction between climate change adaptation and mitigation. Adaptation involves readjusting life to the fact that a certain amount of climate change will inevitably occur. The goal is to make cities as resilient as possible at a local level. Mitigation efforts aim for preventing further climate change through reducing greenhouse gas emissions, and are global in nature. An effective climate change policy for cities warrants the inclusion of both approaches, and they need to be tackled in an integrated manner. Climate change imposes an urgent imperative to move toward sustainable cities that constitute the basis of sustainable development creating an open area of research.

This issue of TeMA Journal vol.9 n.1 (2016) is dedicated to the important topic of climate change and cities. It is intended to prompt a scholarly discourse on some of the above issues under the rubric: Planning for livable and safe cities: Extreme weather events caused by climate change. Five selected papers in the issue present a diverse set of topics in this regard.

The paper on green infrastructure (GI) proposes the idea of climate change adaptation through integration of GI and spatial planning that will improve the microclimate and the urban heat island (UHI) effect. A simple methodology is developed to minimize UHI and to recognize the potential of compact area GI assets and redesign them to optimize climate change adaptation. A second paper studies the post-Katrina urban regeneration. The paper argues that environmental disasters inflicted on cities are not entirely natural, and the associated threats are often man-made. To support this argument, it may be mentioned that there were several problems in New Orleans. For example, levees were weak, communication and responsibilities were not clear, pumping of water was delayed causing hardship and mold, rebuilding was hindered by reduced access to credit due to the US housing collapse, to name few. A third paper examines the urban systems in Italy that are under high seismic and hydrogeological risks. It also reviews the role of urban and regional planning in minimizing risks in Italian cities. In particular, it scrutinizes the status of Italian cities with more than 50,000 populations for hazard risks and how risk reduction is framed in Italian planning system at regional and national levels. The paper concludes that the risk reduction policies and multidisciplinary proactive approaches are only partially cultivated and practically implemented. Another paper describes the land take phenomenon in Metropolitan Naples. It makes the case that a combination of residential land use and expansion of land for agricultural purposes produces an indicator called “residual land” that can provide new insight into the valuation of land take and represent an important element to work on for preventing further land transformation, as well as to protect natural and agricultural land. In the fifth and last paper, it is pointed out that although UHI effect is often linked to large metropolises, in the Netherlands even small cities will be affected by the phenomenon in the future due to the assorted nature of urbanization patterns, particularly in part of the province of North Brabant located in the south of the country. The 2006 heat wave of 21 urban areas in this region vindicates this fact. Based on studies of the land surface temperature supported by data, the paper proposes that the 12 “urban living environments” categories of North Brabant can be reduced to 7 categories thereby simplifying the design guidelines to improve the different neighborhoods.

While this journal issue addresses a very crucial issue of climate change and its effects on cities, not all topics can be covered in a single issue like this; nor can it be covered even in just a few issues because of the breadth and depth of this subject. It is expected that more coverage will be given in the scholarly literature to this critical matter affecting human lives now and in the future.

Società italiana degli urbanisti SIU

XIX Conferenza Nazionale SIU - Catania, 16-18 giugno 2016

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La XIX Conferenza Nazionale della **Società Italiana degli Urbanisti** (SIU), attraverso il consueto confronto tra teorie e pratiche, discute sulle potenzialità dell'Urbanistica e sul suo ruolo, che sembra sostanziale per la ripresa del Paese.

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GREEN INFRASTRUCTURE AND CLIMATE CHANGE ADAPTATION

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ABSTRACT

One of the main challenges urban areas, and more particularly the compact ones, are facing is their adaptation to climate change. In recent years, is had been recognized that a more ecosystem approach to spatial planning can play a critical role in meeting these challenges. Green Infrastructure (GI) and its integration in spatial planning emerges as one of the most appropriate and effective ways to improve microclimate and tackle the impacts of climate change and mainly the Urban Heat Island (UHI) effect. This paper initially attempts to clarify the term GI and portrays its benefits and its role as an important spatial planning tool to fulfill different environmental, social and economic needs of urban areas. Then, the paper proceeds to an empirical evaluation of the role of GI in reducing the vulnerability to UHI effect in a compact urban area of the city of Thessaloniki. For this reason, a simple methodology is developed with a twofold purpose: to recognize the risks posed by climate change and especially UHI and to assess the potential offered by available in a compact area GI assets as well as by their redesign in order to maximize their contribution to climate change adaptation.

KEYWORDS:
Green Infrastructure; Urban Heat Island; Climate Change Adaptation; Thessaloniki.

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绿地系统建设及其对气候变化的适应性

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摘要

适应气候所带来的变化是居住在城区，尤其是紧凑区域的人们所面临的主要挑战之一。近年来，人们越来越意识到在空间规划中运用更加生态系统的方法能够起到应对挑战的关键作用。绿地系统建设及其整体空间规划正是改善局部环境、解决环境变化，尤其是城市热岛效应中最合适和最有效的方法。首先，本文试着阐明绿地系统建设的定义和优势，并描述其在实现城区不同环境、社会和经济需求中作为空间规划工具的重要作用。其次，本文从经验的角度评估了绿地系统建设在降低塞萨洛尼基城密集区的热岛效应中所发挥的重要作用。基于这个原因，我们开发这个简单的方法论是有双重目的的。首先是认识到由气候变化，尤其是城市热岛效应引起的风险；其次是评估在密集区域中绿地系统建设和重新设计对扩大其对气候改变适应性的可行性。

关键词:
绿地系统建设；城市热岛；对气候变化的适应性；塞萨洛尼基城.

1 INTRODUCTION

The interactive relation between climate change and urban areas has long been recognized and documented in a range of studies (Bulkeley & Betsill, 2003; OECD, 2008; Toly, 2008; Kern, 2010; World Bank, 2010; UN-Habitat, 2011, Bulkeley, 2013). Urban areas show obvious signs of what has been called inadvertent climate modification (Oke, 1987). This is due to the process of urbanization and all human, social and behavioral activities related to it, which have intensified environmental problems. Urban environmental problems extend beyond the boundaries of urban areas, thus contributing to global environmental degradation (Gorsevski, Taha, Quattrochi, and Luvall, 1998; Toly, 2008; Bai, McAllister, Beaty, and Taylor, 2010). On the other hand, as relevant literature has highlighted, urban areas are also severely threatened by climate change, displaying a high level of vulnerability to environmental hazards. The emergence of the Urban Heat Island (UHI) -the phenomenon whereby cities appear to be warmer than the surrounding rural area- has been noted as one of the main effects (Oke, 1987; Roth, 2002; Wania, 2007; Memon, Leung, and Chunho, 2008). All of these indicate a rupture in the balance between human and natural eco-systems, resulting in people being cut off from valuable ecosystem services, which in turn has led to a range of consequences including the inability to adapt to, or mitigate the effects of, climate change. At the same time, however, there is a growing recognition, that urban areas represent the best loci both for adaptation to the new and changing conditions resulting from climate change, and for the creation of a sustainable future (Roth, 2002; Toly, 2008; OECD, 2008; Bai, et al., 2010).

Given the local character that both spatial planning and adaptation exhibit, spatial planning, and land use planning in particular, is emerging as a key factor both in sustainable development and in tackling climate change (Davoudi, 2009; Davoudi, Crawford, and Mehmood, 2009; Biesbroek, Swart, and van der Knaap, 2009; Planning and Climate Change Coalition, 2010; Measham, Preston, Smith, Brook, Gorddard, Withycombe, and Morrison, 2011; Yiannakou & Salata 2012; Cashmore & Wejs, 2014). Spatial planning influences the distribution and the spatial dimension of activities and investments of current and future generations. Therefore, spatial planning tools potentially can make a significant contribution in tackling the uncertainty and complexity of climate change. Furthermore, the potential of planning to manage conflicting interests that emerge, to act independently of administrative boundaries and scale governance, to promote participation and to help to generate and disseminate knowledge and best practices, all contribute considerably to the sustainability and resilience of urban areas. At the same time, climate change has had new and unforeseen effects on lifestyle, work, recreation and transport, all of which pose a challenge for planning (Blakely, 2007; Davoudi, 2009; Biesbroek et al., 2009; Yiannakou & Salata, 2012; Hurlimann & March, 2012; Cashmore & Wejs, 2014; Salata & Yiannakou, 2013; van Buuren, Driessen, van Rijswick, Rietveld, Salet, Spit, and Teisman, 2013).

Of particular interest for adaptation is the case of compact cities which, while being widely accepted as representing both the most suitable urban form and the one most appropriate for mitigation, are also faced with the most difficulty coping with climate change adaptation (Pizzaro, 2009). These cities are expected to experience the effects of climate change more intensely, due to their specific characteristics, such as high densities, high traffic rates, congestion, problematic layout plans, lack of open space, decaying building stock and high rates of poverty. All these features are, to a large extent, shaped by spatial planning at the local level (Bulkeley & Betsill, 2003). These inherent features of the compact-city systems constitute the defining factors of its vulnerability, when the latter is defined as a "state" existing within a system before a hazard event occurs (Adger, Brooks, Bentham, Agnew, and Eriksen 2004). Using the concept of "Risk Triangle" suggested by Crichton (1999), "risk" depends on three elements, hazard, vulnerability and exposure, which represent the three sides of a triangle. According to this concept, if we shorten one of the triangle's sides then the size of the area representing the risk is reduced (Figure 1). If the vulnerability of the compact city is regarded as a state, then it could be argued that by intervening in its inherent features -especially those related to urban structure- through spatial planning, we reduce vulnerability and therefore the size of the risk faced by these cities.

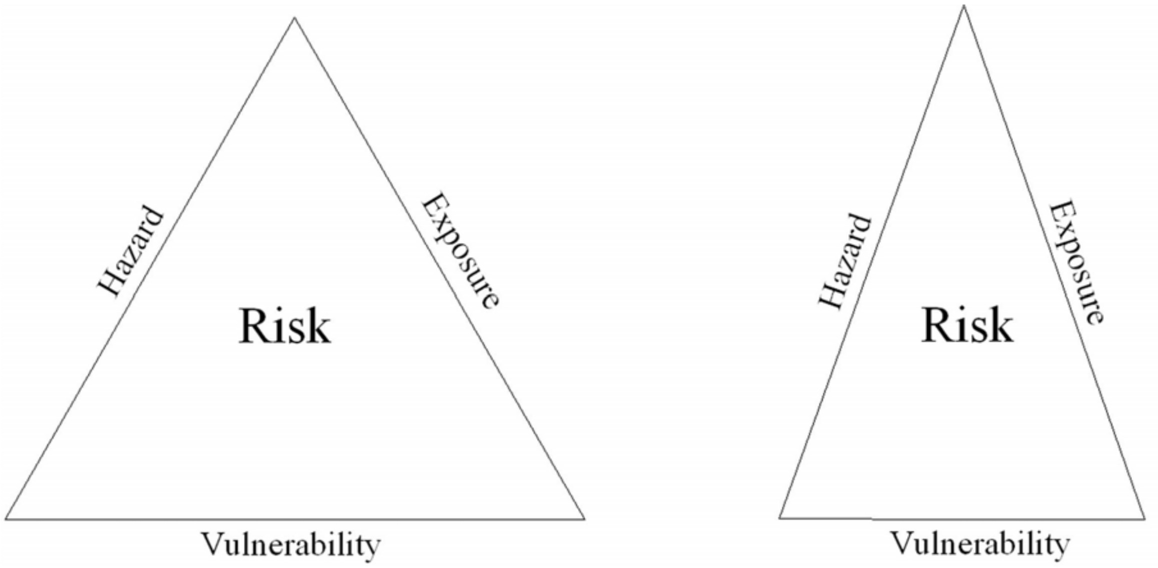

Fig. 1 Risk Triangle (after Crichton, 1999; modified)

One of the tools of spatial planning, land use planning and detailed urban design in particular, is the provision of Green Infrastructure (GI), the latter being recognized in recent years as playing a critical role in meeting the challenge of climate change adaptation. After this brief introduction, the second section of this paper provides an analysis of the term GI and its basic features based on a literature review. In the third section, and using a simple methodology, we proceed to an empirical evaluation of GI assets that are usually available in compact and densely built-up areas, and their potential for reducing a compact's area vulnerability to UHI. The case study was conducted in one of the municipalities of the compact area of the city of Thessaloniki, the Municipality of Kalamaria. Finally, some conclusions are drawn regarding the prospect of incorporating GI into an integrated spatial strategy for climate change adaptation.

2 GREEN INFRASTRUCTURE: DEFINITION AND BASIC FEATURES

Many ecosystem-based approaches for spatial planning have adopted a redefinition of the relations between biotic (people, flora, fauna), abiotic (soil, water, air), cultural and artificial (buildings, roads, infrastructure) components and functions of the urban ecosystem, so as to foster a sustainable coexistence between natural and built (gray infrastructure) environment (Brady, Brake, and Starks, 2001; Schäffler & Swilling, 2013). One of the best and most appropriate planning tools based on this approach, using the method of restoration of ecosystem services and therefore adaptation to climate change (including to UHI), is the provision and design of GI.

Following the definition given by Natural England's Green Infrastructure Guidance (Natural England, 2009), the term GI essentially refers to a multifunctional network of environmental and other assets, public and private, existing and new, covering all spatial scales, while its design and management respects and enhances the local character of the area. Such assets are street trees, green roofs and walls, private gardens, pedestrian and cycle routes, road and railway networks, pocket parks, city parks, regional or national parks, churchyards, school grounds, institutional open spaces, play areas, local nature reserves, sports pitches, allotments, vacant and derelict land, brownfield land, agricultural land, ponds/lakes, rivers and floodplains, urban-municipal plazas etc. (Landscape Institute, 2009). Although the term has been used internationally both in research and policy documents, the review of the relevant literature shows that there is no single and universally accepted and used definition for GI or for its assets. Owing to its multi-functionality, the definition may vary depending on the context (scientific background of scholars), on the stakeholder and/or on the spatial scale in which it is examined (Benedict & McMahon, 2002; Mell, 2008b; Mell, 2010; Wright, 2011; Naumann, McKenna, Kaphengst, Pieterse, and Rayment, 2011; EEA, 2011; Beauchamp & Adamowski, 2013; Hansen & Pauleit, 2014). In addition, as some GI assets are easier to monitor scientifically and to evaluate, they tend to attract more research (European Commission [EC], 2012) and, therefore, to influence the definition of GI. These observable differences in terminology may also result from difficulties in the translation and accurate interpretation of the term (Werguin, Duhem, Lindholm, Oppermann, Pauleit, and Tjallingi, 2005). This could explain the varying designations of GI as approach, concept, networks or structures/spaces (Naumann et al., 2011; EEA, 2011; Lennon, 2014).

Whatever the different definitions of the term, it is worth mentioning that GI is not new as a concept (Benedict & McMahon, 2002). It could be argued that in spatial planning one of the first references that attempted to link urban areas and ecosystem services, was Howard's garden city, presented in 1902 in his book "Garden Cities of Tomorrow", in which the concept of GI may have its roots. It has been proposed that attempts to put the design of GI into practice date back to the late 1970s in the UK (Kambites & Owen, 2006). During the same decade, GI has also been studied in other countries, such as in Germany under the term "landscape design" (EC, 2012). The term "Green Infrastructure" appeared for the first time during the 1990s both in the United States and in Europe (Mell, 2008a; Mell, 2008b; EEA, 2011; Naumann et al., 2011; Lucius, Dan, Caratas, Mey, Steinert, and Torkler, 2011; Lennon, 2014). Yet it is still considered a relatively new EU policy instrument (EC, 2012). For this reason, many GI initiatives were established, which did not, initially, refer to themselves as such (Naumann et al., 2011). However, the different definitions and terminologies, are not contradictory, being generally related and sometimes overlapping (Kambites & Owen, 2006; Naumann et al., 2011; EEA, 2011).

In EU, the term GI was first introduced in the 2009 Commission White Paper, "Adapting to Climate Change". Almost all of the EU legislative documents (regulations, directives, recommendations, decisions etc.) use the term "Green Infrastructure" in connection with landscape resources, with particular emphasis on ecological connectivity. In contrast, the European Environment Agency (EEA) and other European programmes choose to use the term "green spaces", "green systems" or "green structure" when referring to the urban environment or other related issues, (EEA, 2011; Werguin et al., 2005). The term "Green Infrastructure", as such, is widely adopted by the UK's legislative bodies, and used in relevant studies concerning areas within the UK. It is interesting, however, that even in these cases, some important differences in definitions are recorded in the various spatial planning documents, such as the Regional Spatial Strategies (RSS) of the previous planning system in England (Natural England, 2009). For example, Gill, Handley, Ennos, and Pauleit (2007), in their study of the role of GI in adaptation to climate change in the Greater Manchester area, regard GI as a grid connected network of green spaces, defining it broadly to include natural and artificial assets such as street tree planting, green roofs and facades, ground cover, private gardens, greening railway lines, green corridors, natural reserves and sustainable urban drainage systems.

Regarding GI definitions, it is interesting to note the differences between those adopted in the USA and in Europe. In the USA, more emphasis is given to water management and rainwater, and to the connection of GI with gray infrastructure, stressing the need to protect the ecology and natural systems (Kambites & Owen, 2006; EEA, 2011; Lennon, 2014; Mell, 2014). Of course there are also studies using a more ecosystem-based approach, paying special attention to the role of biodiversity, while highlighting the need for a 'smart'/sustainable growth fostered by the development of an integrated planning process. For example, Benedict and McMahon (2002), focused on an interconnected network of green space (such as waterways, wetlands, forests, habitat, greenways, parks, farms, wildlife areas, open spaces), as well as on ecosystem services and biodiversity. Similarly, Brady et al. (2001) point out that GI consists of natural resources such as trees, to which they give particular importance, streams, wetlands, open spaces, street trees, parks, water fronts, lawns, etc., while giving greater emphasis to land use planning and water resources, and to the relationship of gray with green infrastructure. Both these studies pay particular attention to an integrated GI design process. At the EU level, a more clear ecosystem-based approach is adopted, stressing the importance of multifunctional networks of GI assets and of ecosystem services, whereas, overtime, wider and more integrated definitions are adopted. In this approach GI assets include terrestrial and marine/aquatic ecosystems and characteristics, as well as natural, semi-natural, urban and rural areas. Particular emphasis is given to the correlation between adaptation to- and mitigation of climate change, and GI across all planning scales. In relation to GI assets, some projects make a distinction between green and blue infrastructures, whereby the first includes urban vegetation (gardens, parks, productive areas, greenways, green roofs and walls) and the latter, water elements (such as water, rivers, streams, floodplains, sustainable drainage systems and general aquatic ecosystems) (Shaw, Colley, and Connell, 2007; Natural England, 2009; Natural England, 2013; EC, 2013).

Although the design, mechanisms, tools and actions for achieving GI, naturally differ across the various planning systems, given the local approach it also exhibits, this lack of a unified conceptual framework can create misunderstandings and limitations in its planning, design and implementation, as well as communication problems between all actors involved in this process (Mell, 2008a). This could have important implications for the aspirations of local authorities regarding adaptation to climate change, and to some degree, mitigation. GI assets can reduce the negative impact of urbanization in a sustainable manner, preventing urban sprawl, reducing the demand for transport (reducing congestion, noise, air pollution), promoting a land use mix and a more compact city structure, ensuring a sustainable and efficient use of resources and enhancing biodiversity. Therefore, GI has a significant role in improving the urban microclimate and hence tackling UHI, whilst also helping to reduce the risk of natural disasters. There are also some potential problems, for municipalities or individuals, with the implementation of GI: GI is an infrastructure and so it requires investments and maintenance in order to provide services and benefits. However, the implementation cost turns out to be lower than in other practices whereas the implementation of GI prevents possible future costs (Wania, 2007; Santamouris, 2007; U.S. EPA, 2008; Kleerekoper, 2009; Karhu, 2011; Naumann et al., 2011; EC, 2012; Landscape Institute, 2013; Arup, 2014). Moreover, the entire urban population can benefit from the implementation of a holistic GI planning approach (Arup, 2014).

A final factor to consider is the need for an integrated spatial planning strategy based on GI, as such a strategy would offer more efficient ways for local authorities to achieve multiple goals. Integration of GI into spatial planning, which is based on an ecosystem approach, would make the design of GI assets one of the main tools of intervention, thus building a sustainable environment, which is resistant to future challenges and adaptable to future needs. To achieve this, planning must be supported and guided by a number of key principles, which should then be specified according to the characteristics, conditions (environmental, social, political and economic) and needs of each region. Various relevant studies have proposed a number of such key principles (Brady et al., 2001; Benedict & McMahon, 2002; Werguin et al., 2005; Kambites & Owen, 2006; TCPA [Town and Country Planning Association], 2008; Naumann et al., 2011; TCPA and The Wildlife Trusts, 2012; Jaluzo, James, and Pauli, 2012; E.C., 2013; Landscape Institute, 2013; Arup, 2014). These proposals can be categorized according to the following key principles: comprehensive planning, multi-functionality, interdisciplinarity, inclusiveness, sustainable financing, strengthening local features, connectivity, accessibility and data monitoring.

3 ASSESSING THE ROLE OF GI TO CLIMATE CHANGE ADAPTATION IN A COMPACT AREA OF THESSALONIKI CITY

In light of the above discussion, the main objective of the present section is to give an empirical assessment of the role of GI in reducing the vulnerability of a compact urban area to UHI. For this reason, a simple methodology has been developed with the purpose, firstly, to highlight the risks posed by climate change, and especially UHI, in a compact area, secondly, to assess the potential of already existing GI assets for climate change adaptation and, thirdly, to assess how the redesign of these assets could contribute to maximization of this potential. This methodology comprises the following steps:

- Highlighting the vulnerability of the study area to UHI, by using the urban structure data, which include the inherent characteristics of the compact area, in order to map the parts of the built-up area which are likely to be more vulnerable.
- Analytical mapping of the available GI assets, followed by an assessment of the cooling effect of these assets, in order to define which parts of the area studied do not benefit from the cooling effects of GI assets and are, therefore, more vulnerable to UHI.
- Designation of potential planning interventions which maximize the positive effect of available GI assets on climate change adaptation.

This case study was conducted in one of the municipalities of the city of Thessaloniki, the Municipality of Kalamaria, in order to demonstrate the importance of GI in a compact densely built-up area. In these areas perhaps the biggest difficulty, is deciding how to redesign the problematic sections of its layout plan, while avoiding large and costly interventions. Therefore, in these areas, only small scale planning and detailed design interventions within the existing provisions of the planning system are feasible.

3.1 RECOGNITION OF THE STUDY AREA'S VULNERABILITY TO UHI

With a total population of 90.096 inhabitants (2011 Census), the Municipality of Kalamaria, a relatively compact area of the city, is situated in the southeast coastal area of Thessaloniki. The Municipality is a middle-class area with a relatively large proportion of people in the higher professions and a lower proportion of unskilled labourers. The Municipality grew rapidly between 1971 and 2011. This trend led to increased pressure on resources such as land, energy, water and transport systems, and also to higher population densities. This increased pressure, in turn, resulted in an intensification of climate change in the area. Densities in the populated area vary from about 220 to 600 inh./Ha. The layout plan is designed with several routes which lie at right angles to the coast, and the area is built with medium rise, 4-5 storey-buildings. These features generally allow the unimpeded stream of the northwest winds, which provide sufficient ventilation.

Geographically speaking, the area has an extended sea front, with a total coastline length of about 5.5km, and an open flood-protection trench (Peripheral Trench, P.T.) lying along its northern stretch. The climate is Mediterranean, with cold and wet winters and hot and dry summers. An important climatic feature of the study area is its high humidity. Furthermore, based on available data of the Hellenic National Meteorological Service, since 1951 the temperature in Thessaloniki has been increasing, a trend expected to continue. Studies have also shown that despite an increase in humidity in recent years, Thessaloniki has actually become more arid. Moreover, while there has been significant reduction in the levels of annual rainfall itself, rain now falls more rapidly than before (YPEHODE, 2002), increasing the risk of flash floods. The average wind speed is relatively low, reaching only 5.5Kt and blowing in a northwesterly direction. Sea level is rising at higher rate -4.0mm/year- compared to the global average of 1-2mm/year. Regarding data on air pollution, in the Municipality of Kalamaria, only the concentration values for nitrogen dioxide (NO_2) and

Particle Matter (PM10), are relatively high. These higher levels are the result of the central heating systems in houses and increased traffic on the roads.

The percentage of women and the elderly in the Municipality is showing a gradual increase. These two groups are regarded as being more vulnerable to the impacts of climate change, having greater difficulty adapting to it. The effects on the Municipality of its middle-class socioeconomic composition could be interpreted in two ways: on the one hand, that the inhabitants have habits more harmful to the environment than those of lower socio-economic classes and, on the other, the satisfactory educational level of the inhabitants may indicate that they are able to understand the impacts of climate change and adapt better to it, (through information and education programs and/or creation of communication and information platforms), and to participate actively in relevant decision-making processes (Salata & Yiannakou, 2013).

The above data indicates that the Municipality exhibits a high degree of generic vulnerability[1]. In order to assess quantitatively the specific vulnerability of the built-up area to UHI, and since temperature measurements at street level do not exist, two tasks were undertaken:

First we used the equations proposed by Oke (1987 & 1988), which correlate UHI with the size of population (first equation), and with the aspect ratio of street canyons (second equation)[2]. Using the first equation it was estimated that the intensity of UHI based on the population is 5.9°C. The application of the second equation, which correlated UHI to urban geometry, in a sample group of the roads, showed that 84.3% of these roads exhibit a temperature higher than the one calculated by the first equation (Figure 1).

The first trial assessment, although it provides an indication of both the impact of UHI, and of a clear tendency of the study area to vulnerability, is rather simplified, as several important elements are not taken into account. For this reason, in a second test assessment, we used a set of urban structure data (inherent features of vulnerability), namely:

- wind direction in conjunction with roads set at right angles to the northwest sea front (in order to estimate the cooling effect inside the urban fabric produced by the unhindered movement of air masses);
- land use (emphasis was given to commercial and recreational uses to identify where more pressure is created by traffic);
- density of urban units (high densities can result in poor ventilation);
- layout pattern and form (the layout and the position of buildings create a "wall" hindering air movement, coupled with building materials, which emit heat, resulting in heat trapping);
- traffic volumes (to estimate where air pollutants concentration is higher, combined with the two previous data).

The combination of the above data resulted in an area that is anticipated to be the most vulnerable to UHI (Figure 2).

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1 Based on Adger et al. (2004) vulnerability can be distinguished in "generic", factors that determine the vulnerability and the capacity of a system to adapt to a wide range of hazards, and "specific", properties of a system that will make it more vulnerable to certain types of hazard than to others.

2 The first equation correlates UHI with population, through the formula $\Delta T_{u\text{-}r(max)}=2{,}01 \cdot logP - 4{,}06$. The second equation relates UHI with the aspect ratio of street canyons (H/W, where H is the average height of the canyon walls (buildings) and W is the canyon width), through $\Delta T_{u\text{-}r(max)}=7{,}54 + 3{,}97 \cdot ln(H/W)$ (Oke, 1988).

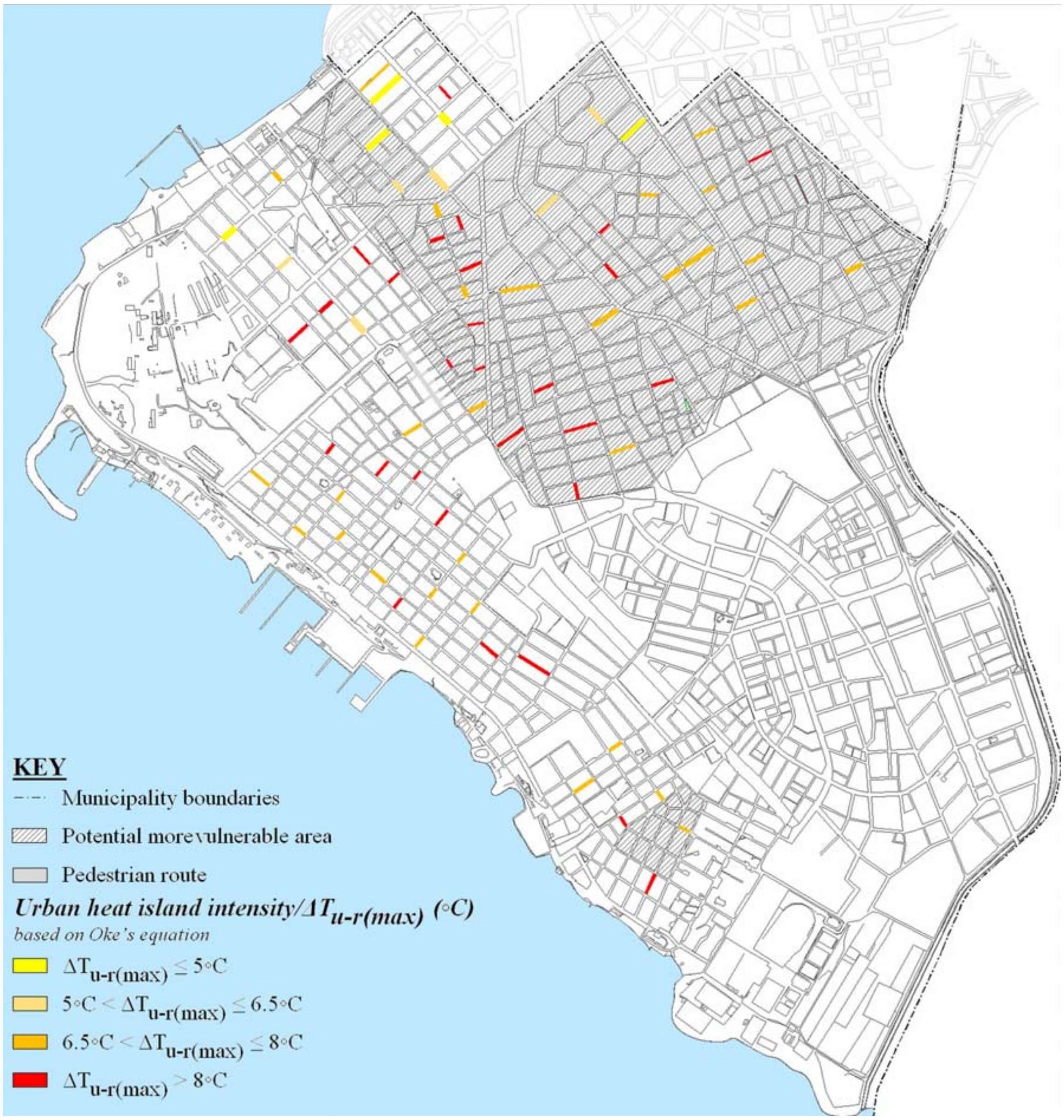

Fig. 2 The most vulnerable area to UHI

3.2 ASSESSMENT OF GI IN THE STUDY AREA

3.2.1 MAPPING OF GI ASSETS

- Detailed field records showed that the main GI assets in the study area can be divided into two categories:
- GI assets of public, or potentially public, character, such as existing and planned open and green spaces, green niches, pedestrian routes and tree-lined streets. Other potential GI assets in this category, such as school and church yards, were also recorded in an attempt to identify potential spaces which either act as, or could be transformed to, green spaces.
- GI assets of private character, such as uncovered parts of private blocks and private gardens, whose preservation as open spaces is relatively manageable with simple land-use planning tools and at no cost.

Mapping of the GI assets in the first category (Figure 3) indicates that the Municipality has a fragmented pattern of small sized urban GI assets, mainly small green spaces, urban parks and tree planting along a large part of the road network. The GI assets of public character which occupy an area of 124.61ha, and which represent 17.31% of the total area of the Municipality, include green spaces, church and school yards which are planted, sports pitches, cemeteries, the Peripheral Trench and pedestrian routes. Almost 36% (44.97ha) of the total GI assets area have already been designated as green spaces by the statutory plan. However, this measure has yet to be implemented due to planning complications related to their property status or initial uses One example of this would be the case of the two barracks in the study area, one of which has been a large brownfield for many years, and the other, which remains with its initial use. Another example would be the case of designated open spaces which haven't been taken over by the local council yet and therefore remain private property (Figure 2). Another problem is the lack of both a network of open and green spaces and of their interconnection with blue infrastructure, leading to a lack of sufficient air flow and the reduced renewal of air. This situation can cause problems, such as intensity of the UHI effect, localized flooding from overburdened drains and intensive precipitation.

Moreover, it was observed that some of the existing public green spaces are not categorized as such in the statutory land use plan, either being included in the road network, or functioning as green spaces while having a different statutory use. Most green spaces are practically deserted and therefore not configured nor maintained correctly, functioning only as open spaces covered either with grass, or worse, with soil. This situation makes the provision of cooling during the day difficult. Thus, these spaces may contribute to the intensity of UHI, especially on hot days, an effect which is intensified in those neighborhoods where there are also some non-built up sections covered by soil. Very few green spaces incorporate blue infrastructures, which would help in improving the microclimate and tackling UHI effect. The existing pedestrian routes are not linked to form a complete network, while the entire Municipality also lacks a network of bicycle lanes.

Interestingly, several green niches within the network of streets occupy a larger area than that of small parks. This fact emphasizes the importance that should be given to their management, aiming at facilitating natural ventilation and reducing air pollution and urban noise. Other important GI assets are the physical configurations of the sea front and the P.T., the main flood protection of Eastern Thessaloniki. This essentially functions as a long green corridor connecting the surrounding natural green elements of the city of Thessaloniki (mountains, sea, rivers). Finally, regarding GI assets of a private character, field recording has shown fairly satisfactory planting of private gardens, flower beds on the pavements and uncovered parts of the blocks. Green facades and roofs were not recorded.

3.2.2 EVALUATION OF GI ASSETS IN RELATION TO THE UHI EFFECT

In order to make a more accurate assessment of GI assets and to demonstrate both the potential and shortcomings of the study area, a set of criteria were constructed to define the relationship between the size of urban parks and their cooling effect (Park Cool Island-PCI). These criteria were based on a synthesis of studies which provide field measurements of temperatures as an effect of PCI in relation to the size of urban parks (Shashua-Bar & Hoffman, 2000; Feyisa, Dons, and Meilby, 2014; Cheng, Wei, Chen, Li, and Song, 2014). Based on this synthesis we propose the following categories of catchment area:

- 100m of catchment area (cooling effect) from GI assets of minimum size 0.15ha and maximum 2ha;
- 200m of catchment area from GI assets of a size at least 2ha;
- 300m of catchment area from GI assets of a size greater than 20ha.

It should be mentioned that the catchment areas selected here are conditional, as there are no specific cooling effect standards set in relation to the size of a GI asset. This is due to the fact that the cooling effect of any GI asset is influenced by a number of factors and requires field temperature measurements.

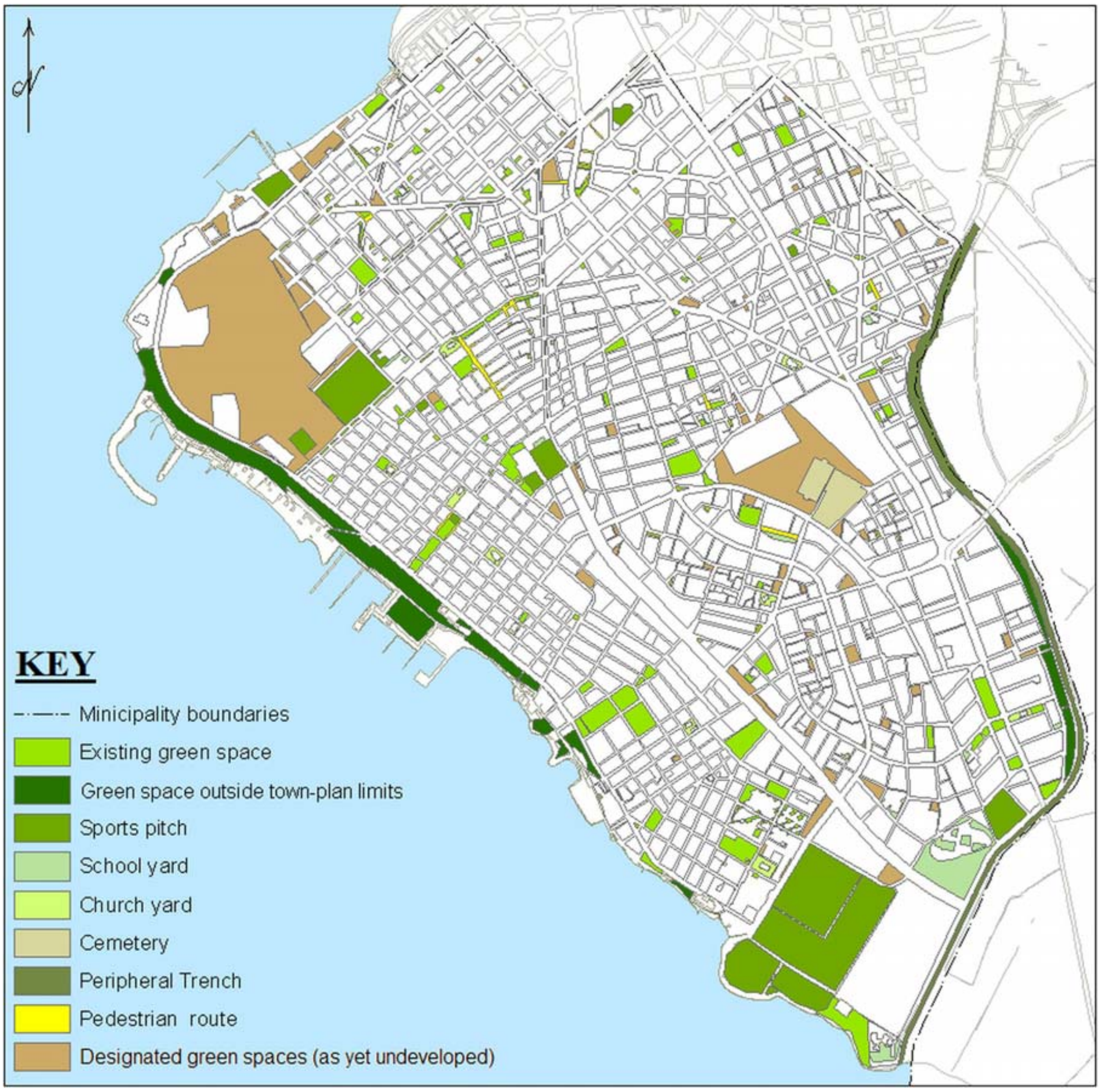

Fig. 3 Existing and planned GI assets of public character

Applying these criteria to existing GI assets in the Municipality, it appears that a large area, specifically 35.96% of the total area, is not served by the ecosystem services that GI assets can offer. This area is, therefore, particularly vulnerable to UHI and climate change (Figure 4). The best serviced areas, based on the above criteria, appear to be firstly, in the coastal area and, secondly, in the southeast area, where there are some large sports pitches and the P.T. Also in this area, there is a large old social housing block, originally designed with a satisfactory percentage of open and green spaces (Yiannakou & Eppas, 2011). The northern part of the Municipality appears to benefit less from the cooling effect of the GI assets. This section of the vulnerable zone coincides with the area defined as vulnerable to UHI, in Figure 1. It is particularly significant that none of the existing GI assets meet the third criterion. On the contrary this criterion is only met theoretically, by those GI assets which, while foreseen by the plan, have as yet, not been implemented. This situation highlights the shortage of public spaces, which concerns the city of Thessaloniki as a whole, and which is further complicated by planning deficiencies (Yiannakou & Eppas, 2011). The need for these sites, in particular the larger ones (over 0.15ha), to maintain their status as designated GI areas and to be developed as such, is illustrated in Figure 4, which shows the areas that could benefit from their GI function. Their development could contribute to a reduction of the vulnerable zone by 28.61%.

Equally important is the conservation of natural and green spaces along the entire coastal line alongside the creation of a linear, continuous green network, which under some circumstances could continue to accommodate its land uses (sport and tourism-recreation). This network may serve as a zone of protection against the expected rise in sea level due to climate change, thereby substantially increasing the adaptive capacity of the Municipality. Moreover, it would allow for the unimpeded flow of air into the urban area, which would reinforce urban cooling. This illustrates the need for both the implementation of the planned green space on the sea front and for the prevention of further reconstruction.

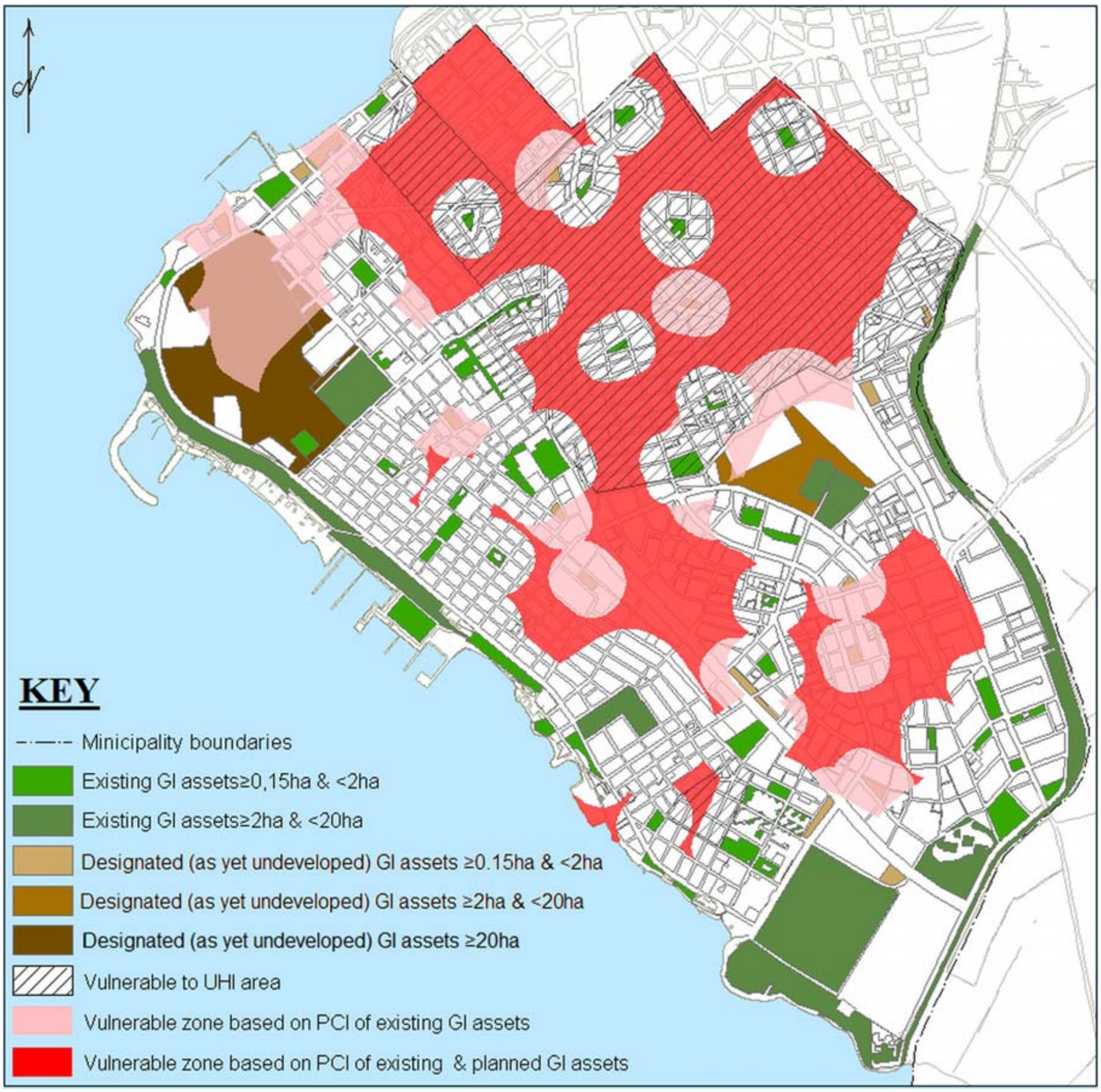

Fig. 4 Vulnerable zones to UHI after estimating the PCI of existing and planned GI assets

Of course, for a more complete evaluation of GI assets a detailed study of tree planting is necessary, as it plays an important role in ensuring that the free flow of air is not hampered. Moreover, the detail mapping of private gardens and those parts of private plots that are not built up is also necessary, because they are important GI assets, which could contribute a great deal to the reduction of the vulnerable zone.

3.2.3 POTENTIAL INTERVENTIONS FOR REDESIGNING GI ASSETS TO INCREASE COOLING EFFECTS

For the remaining parts of the vulnerable zone, which is likely to face more intense urban canyon and UHI phenomena, possible further intensified by climate change, the present study investigated the potential for changing sites of public ownership into GI assets, by making small modifications to the statutory land uses in order to maximize their contribution to climate change adaptation. Such interventions can be summarized as follows:

- Changes in the use of a few non-built-up sites, previously planned for education, sports and welfare utilities, (as they are all public land and their management is easier), provided that the need for these utilities can be met by other sections without increasing the UHI effect. If a permanent land use modification is not possible then such change could be of a temporal character (temporal land use).
- Abolition of small parking spaces and/or increase of pedestrian routes near existing GI assets, redesigning them so as to increase the GI asset's size with the purpose of fulfilling the first or the second criterion of cooling effect.
- Connection of schools, church yards and those parts of private plots that are not built up, with GI assets, again with the purpose of fulfilling the first or the second criterion of cooling effect.
- Appropriate redesign of planned, but as yet, not implemented, non-implemented spaces for educational or sports use, wherever possible, so as to increase their open space and acquire a new GI asset.
- Redesign of currently paved open spaces, such as the central square, to incorporate GI assets connected with those in the surrounding pedestrian zone, thus contributing to a combination of GI assets.

Figure 5 shows the potential reduction of the vulnerable zone which would result from these small interventions. Estimated in terms of the area covered, this reduction could reach a figure of 35.24%, compared to the vulnerable zone after estimating the PCI of existing and planned GI assets (Figure 4).

A complementary action in addressing urban canyon and UHI phenomena would be to turn open, uncovered spaces between the buildings into the blocks and to link (e.g. through pedestrian routes) all these spaces in order to meet the cooling effect criteria and form connected areas of GI assets. Furthermore, the use of blue infrastructures would play a crucial role and should be promoted, especially in regard to sustainable drainage systems. Moreover, given the lack of available public sites, the introduction of green roofs and facades should be encouraged, especially in public buildings. Finally, attention should be given to the design of outdoor parking spaces, as the use of porous materials and vegetation, can help to reduce overheating of these areas during hot days, thereby reducing the creation of hot spots within the compact urban area. These actions, would concern the entire Municipality, not just the vulnerable zone, and may be even more efficient than other measures, as they require the direct cooperation and participation of the residents.The creation of a GI assets network is an integrated spatial strategy, contributing to the delivery of multifunctionality and ecosystem services from all the different GI assets that could be available in a compact area and maximizing their positive effects. Meanwhile, such a network could help in the movement of air masses within the compact urban area, enabling natural ventilation and cooling, resulting in the addressing of urban canyon and UHI effects, alongside the reduction of air pollution. Yet it is necessary also to incorporate pedestrian and cycle networks and to take account of bus routes and the metro line stops. In this way the promotion of environmentally friendly transports will be possible, creating direct benefits for residents' health, while contributing to the reduction of the use of private cars. In conclusion, such a network could contribute to improving both the microclimate and the image of the Municipality. It should be emphasized, however, that such a strategy requires detailed study, mapping and evaluation of the current state of GI assets. It would also require the finding of potential and future sites and GI assets. Existing and statutory land use should also be taken into account.

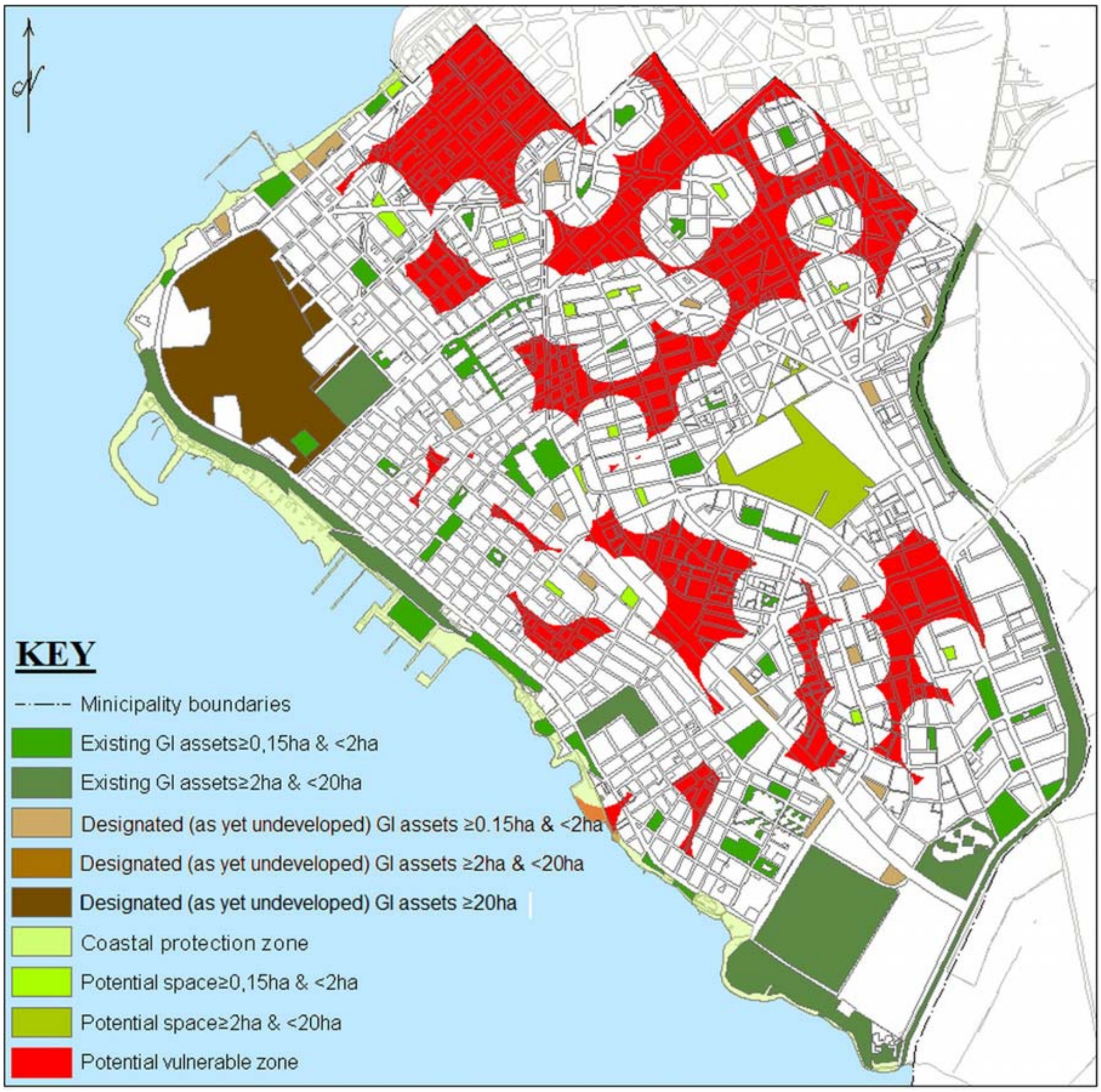

Fig. 5 Vulnerable zone to UHI after maximizing the potential of GI assets

4. CONCLUSIONS

Any strategy of adaptation to climate change for compact cities should recognize that their vulnerability is strongly related to a number of their inherent features relating to the way they are planned. If the degree of vulnerability of an area, and therefore the degree of risk to the impact of climate change, are to be reduced, then, these inherent features, especially those related to urban structure, need to be improved through spatial planning. The provision of GI has been widely recognized as playing important role in meeting the challenge of climate change adaptation. Integration of GI into more ecosystem-based spatial planning, makes the design of GI assets a crucial planning tool for building more sustainable urban environments, resistant to future challenges and adaptable to future needs. As the case study of the role of GI in the Municipality of Kalamaria in Thessaloniki illustrates, the compact city is a place faced by a number of impacts related to climate change, while at the same time offering opportunities for adapting to climate change. Thus in these cities, or parts of cities, it is possible to formulate effective adaptation strategies, adjusted to the local level and to the area's specific features of compactness. The effort to implement an adaptation strategy based on GI in the Municipality of Kalamaria, shows that such a planning and design approach is feasible without necessitating major changes or modifications to existing statutory plans. Basically, this case study highlights the fact that planning GI requires the creation of an integrated network of assets, and that the scattered existence of these assets is not sufficient. Emphasis should be given to updating reliable data and verifying measurements of urban structure, atmospheric pollution and climate-meteorological data, which countries like Greece generally lack. At the same time, there should be detailed and accurate mapping of existing GI assets, especially private gardens and uncover parts of blocks, in order to include them in the integrated GI network. This process is important, given the lack of public spaces in compact areas, along with limited public finances. Information and participation of residents and other actors, and their contribution through volunteer work and funding is also crucial. On the whole, integration of GI into spatial planning, both in existing compact urban areas and in new developments, should be seen as a challenge for the planning systems, as these systems are called on to specify the tools for adaptation to climate change, based on previous knowledge and good practice that has been acquired in relation to the impacts of climate change, such as UHI. An effective adaptation strategy adjusted to the local level and to the specific features of compactness can also contribute, to some extent, to the mitigation of climate change effects.

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Fig. 1: modified form Crichton, D. (1999). The risk triangle, in Ingleton, J. (Ed.), Natural Disaster Management (pp 102-103), Tudor Rose, London.

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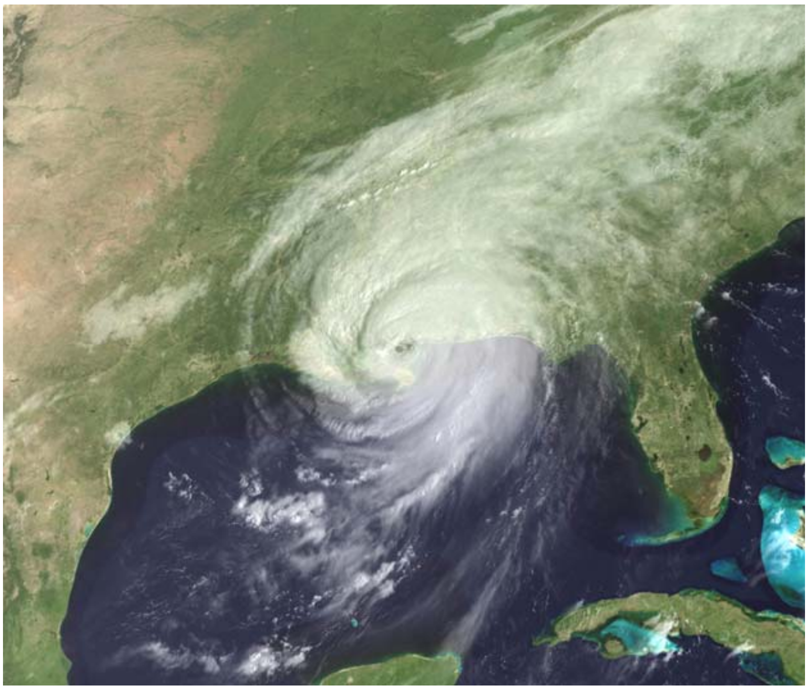

"NATURAL" DISASTERS AS (NEO-LIBERAL) OPPORTUNITY?

DISCUSSING POST-HURRICANE KATRINA URBAN REGENERATION IN NEW ORLEANS

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ABSTRACT

By providing a wide literature review, post-hurricane Katrina uneven urban regeneration in New Orleans is presented here by framing it within a historical perspective in order to underline how environmental threats too often seem to be not so much "natural" but rather man-made as well as to highlight both the reasons and the ways in which, in post-disaster reconstruction, competitive growth has been valued over equity, by directly benefiting those who were already the most advantaged. The aim is to highlight how environmental disasters can be considered as socially constructed phenomena, as they cannot be seen as a single event but rather as a process made by a series of progressive steps occurring within different spheres, which do not necessarily concern the environment only.

KEYWORDS:
Environmental Disaster; New Orleans; Neo-liberal; Hurricane Katrina.

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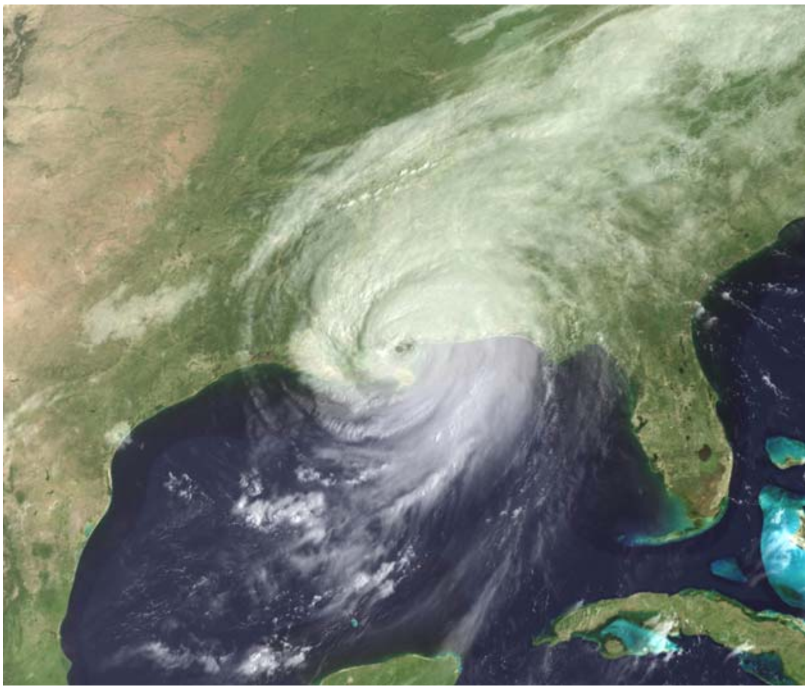

"环境灾害是"（新自由主义者）机会吗？

论新奥尔良受卡特尼娜飓风袭击后的城市重建

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摘要

本文通过文献回顾，展示了新奥尔良在卡特尼娜飓风袭击后城市重建中不均衡现象，并从历史的角度强调了频繁发生的环境威胁并非那么"自然发生的"，而更是人为导致的。同时，进一步分析了在灾后重建中，由于既得利益群体受到直接照顾而导致竞争性增长相较于公平性而更受到人们青睐的原因和方式。本文的研究目的是强调环境灾害是人为造成的。它不是单一的事件，不仅关系着环境本身，而更是由不同领域的渐进发展所构成的。

关键词：
环境灾害；新奥尔良；新自由主义；卡特尼娜飓风

1 HISTORICAL AND CONTEMPORARY ENVIRONMENTAL RISKS

1.1 FACING CONTEMPORARY ENVIRONMENTAL THREATS

The flooding of the city of New Orleans in August and September 2005 following hurricane Katrina is considered as one of the greatest catastrophes suffered by an American city in the last century. Not by chance, such disastrous event is often compared with the 1906 San Francisco earthquake and fire. This is due to the fact that not only most of the urban fabric has been destroyed, with 1,500 dead people and tens of thousands without their homes, but also because of the million people permanently displaced, overloading further local systems. Not to mention the billions of dollars of infrastructure lost: around $40–50 billion including direct property losses ($20–22 billion), still ongoing economic losses ($4–8 billion), and emergency assistance ($16–20 billion).

A wide literature exists on the disastrous management of post-hurricane Katrina in New Orleans, and many scholars draw attention to the way in which climatic extremes – as well as the global financial crisis, energy exhaustion, pandemics and terrorism – contribute to construct an apocalyptic frame that fits well the assumption of the «inevitability of capitalism and market economy as the basic organizational structure of the social and economic order, for which there is no alternative» (Swidgedouw, 2010). Within such a (constructed) catastrophic scenario – and despite the dramatic evidence of climate change – economic growth (i.e.: just *one* of the three "pillars" of sustainability) ends to remain in an absolute prominence in the political agenda, while ecological and social aspects are neglected or, at least, incorporated into the first one through the concept of "ecological modernization", so that profit, planet and people are seen not only as reciprocally implicated, but also as mutually (but asymmetrically) reinforcing, with the third one as the weakest (Boström, 2012), claiming for an actual integration (Connelly, 2007).

But, as post-Katrina urban regeneration projects clearly show, poorer communities are recognized to be more vulnerable not only to the effects of climate change, but also to the effects of adaptation and mitigation intervention (Marino & Ribot, 2012). In this sense, Swyngedouw (2010) focuses on the depoliticizing character of concepts such as "sustainability", "resilience" and "adaptation", real «boundary objects» (Star & Griesemer, 1989) – i.e.: something that can be differently interpreted by the actors involved while retaining a core set of shared meanings, by allowing not only mutual understanding, but also productive misunderstanding, thus creating a connection between different perspectives and interests – whose appeal consists of defending a socio-economic *status quo*, i.e.: nothing but the result of capital mode of production, which precisely is the underlying cause of the ecological crisis itself (see, e.g.: Harvey, 1996; Hartman & Squires, 2006).

In addition, while underlining how such concepts are applied to a wide range of contexts with a wide range of intentions (McEvoy *et al.*, 2013), what is often underlined is the relationship between catastrophic scenarios and the efforts to transform government into a leaner, less directive, more flexible entity (Diefenbach, 2009) – what Žižek (2011), following Lacan, calls «power turned into administration, relieved of its radical responsibility» – with «the growing feeling that adaptation to new social conditions is a *sine qua non* of survival» (Argyriades, 2010) into an apocalyptic wilder and more unpredictable risky environment (see: Beck & Levy, 2013), which seems to be immersed in an «extended present» (Reith, 2004) due to the «space-time compression» (Harvey, 1989) given by information technology of a globalized economy.

This means that, differently from the past and in contrast to earlier assumptions about the "knowability" and controllability of the world, contemporary advancement in calculation – Max Weber's «rational enterprise» (2003 [1958]), i.e.: calculated risk taking (see also: Appadurai, 2012) – has paradoxically ended to generate a sense of radical indeterminacy, where complexity easily turns into chaos.

Such an interpretation undoubtedly offers relevant theoretical insights into how post-disaster recovery are too often addressed, individuating (neo-liberal) causes and unequal social effects. But it fails to solve the question concerning how to plan to face future risks, i.e.: the ways in which planners, despite their limited capacity in forcing wider global political and economic trends, can positively contribute to a more sustainable city/society. In this sense, post-Katrina unequal reconstruction usefully helps to shed lights on the not merely technical nature of planning itself, by better focusing on the political dimension of the so-called "expert knowledge" (and the related implications).

By providing a wide literature review[1], post-Katrina uneven urban regeneration is presented here by framing it within a historical perspective in order to underline how environmental threats too often seem to be not so much "natural" but rather man-made as well as to highlight both the reasons and the ways in which, in contemporary reconstruction, competitive growth has been valued over equity, by directly benefiting those who were already the most advantaged. The aim is to highlight how environmental disasters can be considered as socially constructed, as they cannot be seen as a single event but rather as a process made by a series of progressive steps occurring within different spheres, which do not necessarily concern the environment only.

1.2 LIVING TOGETHER WITH ENVIRONMENTAL DISASTERS

Being located in a highly dangerous place on the subsiding delta of the lower Mississippi river, facing different kind of environmental hazards is not something new for the city of New Orleans: its geophysical vulnerability is given by the below-sea level, bowl-shaped location, accelerating subsidence, and rising sea level. Kates *et al*. (2006) refer of 27 major floods over the past 290 years. A further pressing problem consists of powerful tropical storms occurring during the late summer and early fall season, as in the cases of both back-to-back hurricanes in 1722 and 1723 and a pair of 19th-century calamities.

As a consequence, during nearly three centuries extensive flood protective structural systems were erected, hurricane and river flood forecasting were established and evacuation plans were elaborated by both local and federal organizations, within the frame of an ordinary maintenance managed by local authorities and communities, so that generally the recurring river and hurricane floods produced limited impacts. An example is given by the fact that, after a series of river floods during the colonial period, the government mandated that all landowners build and maintain levees for riparian properties, in order to protect rural agricultural and urban commercial territories.

Furthermore, since the early 1900s people were made aware of risks through newspapers and warning flags and, following the 1915 hurricane, storm forecasting, evacuation plans, preparation of secure structures (generally schools) provided with food and water, and mobilization of government, railroad and shipping companies as well as civic organizations increased (Duffy, 1966). In the 1940s standardized warnings were used and an accurate predictions broadcast on radio started. Finally, by 1949 a guidance for coordination of disaster response efforts (not only floods and hurricanes, but also fires and epidemics) was included into a local plan required by the State Office of Civil Defence.

It is worth remembering that, differently from the past, since the early 20th-century hurricanes large corporations, such as railroad and public utility companies, emerged as the most capable of responding, especially as concerns repairing damaged infrastructures. This rescaling trend increased with the post–World War II expansion of Federal involvement: for example, the 1947 hurricane response was marked by the participation of US army, as in the case of hurricane Flossy in 1956. By the 1990s, Federal Emergency Management Agency (FEMA) and the State Department of Emergency Preparedness had assumed

[1] I am tremendously indebted to all US friends from community development, labour, social justice and advocacy organizations not only for their invaluable help in collecting data and publications (especially the highly interesting papers on the city's social history), but also for their encouragements and useful feedbacks.

responsibilities formerly delegated to civil defence organizations, while the National Guard, the Coast Guard, the Red Cross, local law enforcement, and other government entities continued roles performed under the previous administrative apparatus.

Following hurricane Betsy in 1965, a method to calculate a hypothetical "standard project hurricane" was developed by the Weather Bureau and the Corps of Engineers. It stated a forecasted probability of recurring of only once in about 200 years, with winds of 100 miles/hour and a speed of 11 knots/hour. This guided initial hurricane protection levee design and construction following hurricane Betsy in 1965, which had the most extensive impact on New Orleans: in fact, it flooded 43% of the city and seriously damaged over 14,000 homes, with a evacuation involving local, state, and federal officials together with the Red Cross and private companies. Thanks to the new protection system, infrastructure, schools, and businesses functioned a near-normal level one month after the disaster.

In addition, not only the Congress almost immediately provided funds to expand and strengthen the region's levee system (Colten, 2006), but it also considered flood insurance legislation with «a new sense of urgency» (*id.*). This led to the creation of the National Flood Insurance Program (NFIP) in 1967. New Orleans qualified to participate – subscriber rates in the area were the highest in the country (Colten, 2005) – and updated its building codes to call for higher floor elevations.

1.3 NATURAL OR MAN-MADE?

But advancement in protection following hurricane Betsy (1965) generated an unexpected and undesired effect. While before Betsy a relatively small population lived in the most vulnerable locations, a combination of new hurricane protection levees and modest-sized storms with little damages led to a non-unpredictable population growth. In fact, as there were no restrictions on development within the expanding levee system, people were allowed to settle in the recently protected suburban areas. As a result, between 1965 and 2005, developers built 22,000 new homes in previously uninhabitable sections of eastern New Orleans (Burby, 2006), so that the city lost population to its suburban territory.

An example of such relevant shift is given by both the neighbourhoods around Jefferson and St. Bernard parishes, in which the number of households swelled between 1960 and 2000 from 55,351 to 176,234 and from 8,104 to 25,123, respectively. This means that the pre-Katrina estimated population of 437,186 inhabitants lived in a bowl, half below sea level, between the natural levees of the Mississippi river and the built levees (pierced by canals) along Lake Pontchartrain (Colten, 2005). At the same time, while new housing in the city increased in the most flood-prone areas, the levee system crept toward completion: construction proceeded in fits and starts and costs spiralled, making it ever more difficult for local partners to secure adequate funding. Thus, on the one hand, competition among Louisiana interests, economic cycles, and national spending priorities disrupted steady funding. On the other, little consideration was given to the fact that each component was part of a comprehensive protection system. As a result, at the time of Katrina in August 2005, some portions of the hurricane protection system were nearly complete, while others were about one-third complete: protection and the reduction of risk remained uneven (Colten, 2006).

With a ring of levees around the urban area, subsidence within that circle, and increased land cover, New Orleans faced increasing problems from rain-induced flooding. In the 1990s, the Corps of Engineers developed a massive program – the Southeast Louisiana Drainage Project – in order to improve the region's internal drainage and thereby reduce flood risk from precipitation by enlarging the capacity of both the drainage system and the pumps lifting the water into the river and lake. This system was largely in place by 2005 (Colten, 2005) and, according to Ergen (2006), it had demonstrated its benefits. But, despite such improvement, when Katrina passed over the area, levees proved inadequate: overtopping and failure in several locations allowed floodwaters to rush through the low-lying neighbourhoods. This means that the crucial unanticipated event during Katrina was the failures of levees along the major canals and the subsequent flooding of the city. In fact, even if levee overtopping could also be foreseen, the four massive breaches could not, so that, at the peak of flooding, some 80% of the city was under water. Following a second inundation due to hurricane Rita in late September, it took 53 days from Katrina's landfall to pump the city dry. In addition to incomplete protective works, the State's emergency plan had not been updated. In fact, following hurricane Betsy in 1965, engineering designs for new and improved protective works took into account the estimated frequency and magnitude of a standard project hurricane and its effects, but land subsidence and rising sea level were measured at *that* time. Nineteen years later, these estimates were still being used even if subsidence within the levees had lowered the land surface and sea level had risen. On the other hand, the multi-decadal rhythm of frequent hurricanes and the frequency of more intense hurricanes enhanced by global warming have increased as well. Furthermore, publicly available risk assessments in the form of FEMA maps of the 100 year floodplain had never included sea-level rise or land subsidence effects. It is worth underlining that an extraordinary event such as Katrina, which had been partly experienced in hurricane Betsy (1965), had been anticipated by the expert community for many years, reported on publicly just two years before Katrina in a widely disseminated account in the newspaper, and simulated in an emergency exercise a year before Katrina. Therefore, New Orleans was a catastrophe waiting to happen with extensive and repeated warnings from both scientists and the media that the "big one" would eventually hit the city.

Katrina brought severe but not catastrophic winds, record rainfalls and storm water damage, followed by the collapse of major canal floodwalls, allowing water to fill the bowl in about 80% of the city. All of these are only partly natural phenomena and have undoubtedly been made worse by human location decisions: extraction of groundwater, oil and natural gas, canal development and loss of barrier wetlands, internal rainfall storage and global warming (not to mention the design, construction, and failure of protective structures). It is precisely in this sense that the disaster seems to be not so much "natural" but rather "man-made" (Pelling, 2001). And, as the uneven reconstruction clearly shows, it was socially constructed (Hartman & Squires, 2006).

2 A NEOLIBERAL STORM?

2.1 PUBLIC HOUSING AND CITY'S BLACKNESS.

Prior to hurricane Betsy, population growth trends rapidly resumed after calamities: neither epidemic disease nor floods stymied population growth. This, of course, was due to national and regional immigration patterns during 19th-century, when waves of Irish and, later, Italian immigrants continued to arrive in the city despite yellow fever epidemics. Following hurricane Betsy in 1965, however, a different set of interrelated factors conspired to stimulate a further population adjustment: interstate highways and, over all, a general out-migration of affluent whites from urban centres pushed depopulation of the city. In fact, between 1960 and 2000, it experienced a general population loss and, over all, a shift from a white (62% in 1960) to black majority (67% in 2000).As already highlighted, while the Corps of Engineers began improving levees around the urban core, they also built improved protection for adjacent suburban areas, including Jefferson and St. Bernard Parish, and eastern New Orleans. Thus, the combined influence of transportation changes, white-flight, and expanded hurricane protection area, plus the "oil bust" of the '80s, produced a more socially segregated city, with a spatially concentrated poor population, while, at the same time, the city area became a more dispersed urban region, particularly by 2005 (Colten, 2005; Burby, 2006).

The increasing of black poor population meant that public housing became a crucial component of New Orleans's housing market (Reichl, 1999): in fact, immediately prior to hurricane Katrina, one in every ten residents of New Orleans lived in some form of public or government-supported housing and, given the black presence among the poor in the city, nearly 100% of the city's public housing residents were black (and 64% female) (in: Pardee & Gotham, 2005). Thus, pre-Katrina New Orleans was a poor city with many people living below the poverty line: it is worth remembering that a series of legislation of the late 1960s and early 1970s, known as the Brooke Amendments, ensured that the very poor would have access to public housing by tying the cost of rent to a tenant's income. This legislation required a rent ceiling of no higher than 25% of a resident's income, but it did not provide sufficient compensation to local housing authorities for the massive loss in rent revenue that it created.

This reduction in public housing resources furthered the poor conditions of public housing units because it meant even fewer funds for maintenance (see: Kamel, 2012). In 2004 New Orleans reached the seventh highest poverty rate (23,2%) within the USA as well as the second highest concentrated poverty among the 50 largest cities in 2005 (in: Berube & Katz, 2005). But it was not simply a matter of poverty, which, however, was worsened by the replacement of the strong unionized local port economy by a low-wage, tourism-dependent economy.

It is worth remembering that, as shown by the well-known "anniversary parade" (organized by indigenous black associations) that run every Sunday from August until April (see: Regis, 2001; Gotham, 2007), New Orleans – «the most un-American American city» (Spain, 1977) – has always played a relevant role within the history of Afro-American activism and collective action against socio-spatial racial and economic segregation. In the USA race is a «marker of class and status» (Gans, 2005) and New Orleans is no exception, though its racial ordering is more complicated than most US cities. Hirsch and Logsdom (1992) provide a detailed account of the unique ethno-racial origins of the New Orleans region, leading to the city's three-tiered racial structure that includes also Creoles. Furthermore, in addition to the city's unique Afro-American and French fusion roots, New Orleans also incorporated refugees from St. Domingue (Haiti) following the slave revolution that established the first free society by people of colour in the Western hemisphere, so that colour-led and colour-focused organizing and political development has always been central to the city's development and identity.

New Orleans' historical residential settlement patterns were traditionally mixed racially and by class, with slaves and non-white or immigrant domestics that lived in the neighbourhoods behind their white employers. As such, the construction of segregated public housing in the 1930s and 1940s was one of the first and most demonstrative contemporary acts of «legally enforced residential segregation» (Fussell, 2007). As a result, on the one hand, as «ethno-cultural divisions» mean «colour, class, language, religion and geography» (Hirsch, 2007), racial symbolic boundaries ended to overlap with New Orleans's political, economic and neighbourhood (i.e.: socio-spatial) spheres, with a constant struggle for the distribution of political and material resources. On the other hand, the city's tripartite racial system co-existed in tension with the traditional "American" black-white dichotomy, with Creoles that historically resisted this black-white ordering, challenging the American colour-line.

Since «buildings and their neighbourhoods were the settings where New Orleanians defined their identity, developed their customs and rituals, and understood their sense of place» (Kingsley, 2007), public housing was architecturally and culturally significant: in fact, given the city's historic architecture, disproportionate poverty and inequality, and intense resident and economic segregation, New Orleans communities were organized entirely around dense, close-kin and neighbourhood networks, whose physical and visible symbol consisted of public housing.

But, even though tourism and hospitality industry had long “othered” such black identity, marketing it as a short, «swinging» (Woodside *et al.*, 1989) getaway from normal life, in order to represent the «respectability of blackness […] key values of [...] respect, fiscal power, order, solidarity, peace, community uplift, and beauty» (in: Regis, 2001), before Katrina New Orleans still was «one of the nation’s most working class cities» (Mizell-Nelson, 2008), where urban struggles included both Afro-American and Creole activism as well as strong waterfront unions. As a result, contentious racial and cultural politics between the city’s neighbourhoods and tri-partite ethno-racial populations (Hirsch & Logsdon; 1992, Hirsch, 2009, Hirsch & Levert, 2009), between the city and its suburbs, and between the city and the state, reinforced the city’s socio-spatial isolation as a predominantly poor, predominantly black, predominantly democratic city in the US “deep South”.

2.2 POVERTY AS A DISEASE (AND PLANNING AS A THERAPY) ON THE BACKGROUND OF WIDER RESCALING PROCESSES:

Despite being well-informed of the worst case scenario of a rare hurricane event such as Katrina impacting New Orleans, local, state and federal governments appeared as completely unprepared for the nightmare that unfolded from the breached levees and the reality of the poorest and most vulnerable struggling to survive in the rising flood waters. The Army Corps of Engineers bore responsibility for maintaining the now crumbling levees, so that disaster response (and its failure) fell under federal jurisdiction (Davis, 2006).

When Katrina struck, Republicans controlled both houses of Congress and the White House. President Bush was «severely criticized at home and abroad for an abysmal response to the storm», by focusing on «the issue of race and accusations of racism manifested as indifference» (Graham, 2009) because added to the scale of Katrina's physical destruction was the unequal impacts suffered by the city's poor – predominantly Afro-Americans, predominantly renters (see: Baxter, 2014) – due to the city's disproportionate poverty, racial inequality, and urban decline. Bush responded to criticisms by acknowledging the legacy of racism and inequality that left New Orleans so vulnerable to Katrina, but his recovery policy reflected his Administration's agenda of further government privatization and rollback of social services (Berger, 2009). Not by chance, a Bush’s declaration was: «the private sector is critical in the rebuilding effort» (in: Dreier, 2006). This is why, according to many scholars, under Bush, Katrina recovery was irrevocably shaped by ideological, controversial federal redevelopment decisions.

In fact, on the one hand, the federal government handed out no-bid contracts for cleanup, refused to expand federal service provision to meet the needs of the displaced, and used tax credits as the primary vehicle for reconstruction. On the other hand, in June 2006, the Department of Housing and Urban Development (HUD) announced its plan to demolish the so-called "Big Four" public housing projects and to replace them with mixed-income properties, substantially reducing the number of affordable units (for a detailed account, see: Graham, 2009). What is to be highlighted here is that one of the “Big Four” (C.J. Peete) was situated on natural high ground that was relatively unharmed in Katrina’s flood waters and had seen its populations expand to more than 100% of pre-Katrina numbers.

On the other hand, the local authorities – which are described by Hirsch and Levert (2009) as «ineffectual, corrupt, racially polarized» (with citizen distrust as a result), being New Orleans a regime-less city, having neither a shared agenda, nor governing coalition, nor resources, nor «a scheme of cooperation» (Burns & Thomas, 2006) – soon proved to be incapable of facing the «cement life jacket» (Powell, 2007) due to enormous reconstruction challenges, without a strong economy to pull the city back from the brink. Furthermore, both the city and the State of Louisiana lacked a collaborative tradition even with the federal government, so that, since the beginning, the mayor Nagin prioritized his relationship with the White House in deciding how to proceed in post-hurricane recovery (Burby, 2006). Anyway, there was little alternative at the local level: in fact, having the city lain off 3,000 workers, was effectively bankrupt, and was practically «disintegrating» after Katrina (*id.*).

Federal and local policies, however, were sustained by a sort of institutionalized ideology about status and moral worth of different social groups (see among the others: Thompson, 1998), especially poor Afro-American women. More generally, New Orleans – as a declining, low-income black city – came to symbolize the social isolation and immobility ascribed to an Afro-American urban «underclass» (Wilson, 1987) and this paradoxically led to blame the city and its residents for their misfortune after the storm.

Representations of the typical "cultural pathologies" assigned to low-income urban African-Americans – irresponsibility, disorderliness, fatalism (see: Lipman, 1998; Wilson, 1987; Thompson, 1998; Berger, 2009; Flaherty, 2010), i.e.: a sort of anathema to white Protestant "American" ethic of hard work, efficiency and rationality, mirrored in US citizens' high geographic mobility, privileging the nuclear family, «weak ties» (Granovetter, 1973) and architectural and design homogeneity – were merged by the media with economic malaise, white population decline, lack of a strong government regime, local corruption and high crime in order to highlight the city's disease and, consequently, the need of a "therapy" given by an intervention from outside (see: Imbroscio, 2008; McCann, 2001; more generally, on planning as a therapy, see also: Calabi, 1979; Scoppetta, 2014).

Especially the "Big Four" started to be described by media – advocating for de-concentration strategies – as «welfare queens», «isolated and steeped in abject poverty [...] insular neighbourhoods where strangers were not welcome», «breeding grounds» for crime, disorder, dysfunction and pathology, with residents as «among the most violent underclasses in the country», living in one of the most «seriously challenging big cities» in the USA (press articles cited in: Dawson, 2006).

On such a background, not surprisingly the Congressman Richard Baker exulted: «we finally cleaned up public housing in New Orleans [...]. We couldn't do it, but God did» (in: Hirsch & Levert, 2009; Flaherty, 2010). Similarly, James Reiss, one of the mayor Nagin's closest advisers and richest contributors: «those who want to see this city rebuilt want to see it done in a completely different way: demographically, geographically and politically. [...] I'm not speaking for myself here. The way we've been living is not going to happen again or we're out» (in: Powell, 2007). According to the HUD Secretary Alphonso Jackson, New Orleans would become «smaller and whiter for the foreseeable future» (in: Graham, 2009; in general, on arguments of this kind, see: Smith, 1996).

Such declarations seem to be aimed at definitively cancel decades of non-white government in the city. In fact, across the city's 73 officially recognized neighbourhoods (and the almost 200 unofficial ones), family and inter-generational networks were deeply rooted at the neighbourhood and even block level, with high degrees of sense of community and commitment to place, both important ingredients in Chaskin's (2001) model of community capacity. This had led to the growth of a black political leadership (Germany, 2007) which was involved in a partnership concerning how War on Poverty funds ($100 million) had to be spent in the city in less than a decade. Furthermore, Black activist groups had come together with white liberal elites to develop federal programs by driving funds into low-income racially segregated neighbourhoods (Spain, 1979; Mahoney, 1990). Even though this period of inter-racial collective action had ended in violence between Black Panthers and the police, it had provided an opening for mayor Moon Landrieu to integrate City Hall, and for a new generation of black leadership to enter politics.

In addition, even Creoles – which historically resisted the traditional American black-white ordering – had shifted from their originally radical politics and had elected Dutch Morial, the first non-white mayor of New Orleans (Hirsch, 2009), a position Creoles held until 2010. This is why, in his re-election campaign in 2006, the mayor Nagin faced a racially polarized electorate over the possibility that whites could re-take the mayor's office for the first time since 1978.

2.3 HURRICANE KATRINA AS AN UNEXPECTED OPPORTUNITY

According to many scholars (see e.g.: Arena, 2007; 2011), post-Katrina reconstruction is to be framed within the neo-liberal shift concerning public housing occurred since the end of the 90s in the USA. Currently, just over 1 million units of public housing is home to 2,03 million people (Right to the City Alliance, 2010), which are some of the poorest and most vulnerable in the USA, with the elderly (31%), disabled (32%), children (41%), single mothers, black and Latinos overrepresented, and an average income of $11,295 (with 49% of non-elderly, non-disabled households getting their primary income from wages).

This is why public housing has become the predominant symbol of the federal government's failure to address the persistent problem of urban poverty in the USA as well as one of the few policy arenas still remaining outside the uncertainty of the market.

Following the de-concentration thesis – based on the idea that physical and social isolation of urban poor communities leads to a "culture of poverty", made by high rates of crime, disorder, violence, drug use and unemployment, and limits their exposure to the economic opportunities, role models and values present in middle-class communities and constituting a fungible social capital (Greenbaum *et al.*, 2008; Goetz, 2003) – a federal program (HOPE) was developed (see: Reichl, 1999; Pardee & Gotham, 2005; Popkin *et al.*, 2009). It consisted of the demolition of public housing and their replacement with re-built mixed-income properties as a strategy for combating poverty by incorporating the poor in to the market as well as a tool for urban development. Supported by federal subsidies and in partnership with housing authorities, private developers and community-based organizations, through the 2000s about 100,000 "severely distressed" units were demolished and replaced with about 60,000 new units at a range of rental prices.

It is estimated, however, that 60% to 70% of tenants never returned to the former sites (Ehrenfeucht & Nelson, 2011), and a portion of residents disappeared from housing authority's rolls entirely (Popkin *et al.*, 2009). Further criticisms describe the program as a land grab and a gentrification tool, since the «rationale for mixed-income development [...] has nothing to do with lifting families out of poverty and is simply based on enabling the private development of valuable inner city real estate» (in: Joseph *et al.*, 2007). The focus is on privatization, gentrification (Slater, 2006; Imbroscio, 2004; see also: Thompson, 1998, Lipman 2009), de-regulation and the weakening of the state and social safety net as a tool to enter in the globalized economy at the expense of the poor (Jessop, 2002; Peck, 2006; Gotham & Greenberg, 2008). A further argument points out that, even if mixed-income policies are technically race-neutral yet have explicit implications for poor urban non-white communities (Joseph *et al.*, 2007).

Even in New Orleans, prior to the storm, the St. Thomas redevelopment into the physically attractive New Urbanist River Garden (with less than 20% of former tenants returned – see: Graham, 2009) had been the flagship of the described trends towards de-concentration and mixed income communities. At the same time, the city reached the highest vacancy rate of any major US city at that time, with almost 1/5 houses empty in the decade prior to the storm.

After hurricane Katrina, instead, New Orleans was transformed from a weak to strong housing market. Indeed, the centrepiece of the Bush administration's Gulf Coast recovery strategy was the creation of a Gulf

Opportunity (GO) Zone (modelled on Empowerment Zone legislation from the 1990s) providing $8 billion in tax breaks to stimulate business investment or expansion and affordable housing redevelopment in the devastated area, which included zones with modest hurricane damage.

Prior to Katrina, HUD (which in 2002 had taken control of the local housing authority) had hosted about 5,100 families in public housing and 9,000 using vouchers (49,000 people, more than 10% of the city's population) (see: Kamel, 2012). As the state devoted the vast majority of its re-development funds ($10,4 billion) to making (mainly white – see: Fussell *et al.*, 2009) homeowners to rebuild their properties (despite disproportionate damage to the city's non-public housing), allocating only about $1 billion to rental properties (Clark & Rose, 2007), displaced tenants were significantly under-represented in the city's recovery plans.

Furthermore, as thousands of evacuated residents' home were likely inhabitable, housing destruction became an urgent problem that led to a tenants' permanent dislocation from the city. Without their voice, the city's recovery process ended to be dominated by elites, i.e.: government, business representatives and the white residents whose house was comparatively unscathed or who possessed resource to rebuild. On the contrary, considering the city's «unique character and [...] intractable issues of race and class seemed to call for deep knowledge of local people, organizations, and practices» (Rubin, 2009).

Katrina has removed a significant portion of the city's undesirable, seemingly intractable, pre-storm features utilized mainly by the working and very poor – beyond public housing, failing public school system, hulking public hospital. The (whiter and wealthier) city today has about 335,000 fewer people (current 158,353 inhabitants, of which only 22% African-Americans and no longer 67%) than prior to the storm. The New Orleans City Council, with a white majority for the first time in two decades, has approved demolition of public housing (see: Nelson *et al.*, 2007) – imbued by the people and networks that lived in them over generations (Kingsley, 2007) – in December 2007 (in: Graham, 2009). At the same time, «half of the working poor, elderly and disabled who lived in New Orleans before hurricane Katrina have not returned. Because of critical shortages in low-cost housing, few now expect tens of thousands of poor and working people to ever be able to return home» (Browne-Dianis & Sinha, 2008).

3 WHICH LESSON FROM KATRINA?

Today, CJ Peete and St. Bernard (now Harmony Oaks and Columbia Park, respectively) are mixed-income communities under development, while the Lafitte site, the only one with developer commitment to one-for-one replacement, stands empty after the bottom fell out of the tax credit market. Replacement mixed-income developments, however, will offer fewer than 2,000 units, of which only about one-third will be deeply subsidized at public housing rates.

At the same time, despite a waitlist of over 17,000 families and rather than remediating and reopening indisputably needed housing, those already existing are systematically demolished (spending $3 million) and about 80% of pre-storm public housing residents were given vouchers, despite the shortage of housing in the local rental market, where rents have risen anywhere from one-third to double (Kamel, 2012). Obviously, the bottom fell out on those credits given the US housing market collapse and global economic recession has obviously worsened the situation.

According to Hirsch and Levert (2009) government/elite post-Katrina redevelopment plans reflect «social engineering thinking going on [...] about whether poor, black people [...] have the right to come back». Even if the "right to return" is mentioned in HUD demolition plans (Graham, 2009), in the reality it is tied to whether or not individuals and communities had the resources to reclaim their homes and neighbourhoods, so that «entire neighbourhoods are struggling to prove their right to exist by showing they can rebuild» (Powell, 2007). While the state – supported by its planning/policy networks (Domhoff, 2009), i.e.: by the dispersal consensus (Imbroscio, 2008) – is empowered to decide behind closed doors the future of their life-space, given their sort of "circumscribed citizenship", for marginalized and vulnerable households, the choice to fight or accept development is extremely imbalanced.

This is why, despite the fact that demolition had been proceeding around the USA with limited opposition for almost fifteen years, even if cutbacks have arguably displaced more people than Katrina (Foster, 2007), the "battle for public housing" in New Orleans has become so outsized and symbolic (see, e.g.: Flaherty, 2010; Foster, 2007 and many others...).

But this ends to hide the need for planners of learning from Katrina's mistakes, even in the light of a different approach to human-nature relationship. After all, what sets resilience in human communities – including planners' community – apart from biotic ones, (still) is the capacity to learn from past experiences and employ strategies to contend with future events.

More generally, Katrina as a case-study offers very useful insights into the risks – already clearly highlighted by Davoudi (2012) – related to the ways in which notions are translated from the natural and physical sciences to the social sciences on the basis of the assumption that social systems operate in similar ways to the those in the natural or physical world. Such a "migratory process" of scientific concepts tends to produce «boundary objects» (Star & Griesemer, 1989; see also: Brand & Jax, 2007), i.e.: "objects" (such as texts, ideas, projects, and so on) provided with different and only partially overlapping meanings, so that they can be interpreted differently by the actors involved, by allowing a mutual understanding or, if one wishes, productive misunderstanding that, however, can usefully favour connections between different cultural perspective and interests.

An example in this sense is given by the concept of resilience. By now a large literature exists on the different meanings of a term (among the many, see: Alexander, 2013; Carpenter *et al.*, 2001) which is increasingly adopted by academic scholars, policy makers and practitioners on a variety of scales and in a variety of ways: as a descriptive or normative term, as a (sometimes ethical) paradigm or as a theory (Strunz, 2011), as a desired outcome or as a process leading to a desired outcome (Kaplan, 2010).

Even in the natural and physical sciences, however, very different meanings co-exist. From an engineering perspective, resilience is the ability of a system to return to its *preceding equilibrium state* after a disturbance. On the contrary, the ecological concept of resilience rejects the idea that systems can and should return to their pre-crisis state, as they rather seek to adapt and evolve in the aftermath of that crisis by changing their own structure and configuration, so that resilience means *establishing a new equilibrium*. Evolutionary resilience goes forward by assuming that the drivers of change are not only external, but they can also be internally produced and involve gradual processes of change rather than sudden and unexpected shocks (see: Holling, 1973; but also 1996).

Thus, which resilience planners refer to when they use the term in planning theory and practices? Explicitly clarifying the approach becomes a relevant matter not only in terms of intellectual honesty but also (and especially) in the case of planners aimed at sharing their "expert knowledge" with local communities in order to empower them by also considering (also historical) practices and communities bottom-up initiatives as relevant knowledge sources (from a methodological point of view, a useful and detailed example in this sense is given by REsilienceLAB's experiences, in: Colucci, 2012).

In fact, especially if resilience is intended within the framework of the complexity theory, not considering the constructive role of synergies and feedbacks would lead to the suspect that resilience necessarily implies winners and losers, the latter having to "adapt" while the former having not.

As a matter of the fact, already-marginalized households are generally likely to be amongst the losers, raising important issues of socio-political economy at the local or even higher level (Berkhaut, 2008). As a consequence, assessments of resilience in social-ecological systems should not only consider the most general system level, but also take into account possible trade-offs and asymmetries in resilience between different groups and individuals within the same system, especially when – as in the case of New Orleans – the framing of system boundaries is a matter of conflict.

As post-Katrina unjust reconstruction clearly shows, the use of resilience as a wide "umbrella term" risks to appear as a way to hide conflicts and power relations, by creating further tensions not only among those involved in implementing resilience, but especially among those who find themselves forced to become resilient. Therefore, a simple and unreflecting application of the resilience concept into social and political matters will inevitably run into substantial difficulties.

Many authors point out that other concepts with a stronger social focus should be connected with the notion of resilience, in order to remove the suspect of resilience as a technical apolitical framework, in which the transformative dimension in terms of social justice ends to be ignored or forgotten. For instance, in order to be usefully applied in planning theory and practices, a concept that should be combined with resilience is "vulnerability", i.e.: «the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt» (in: Adger, 2006).

A further concept consists of "agency", a term typically used to characterize individuals as «autonomous purpositive and creative actors, capable of a degree of choice» (Lister, 2004). In this way, resilience could be able to capture under its "umbrella" also the freedom people have to negotiate their own lives (including their own resilience) (in this sense, see: Mackinnon & Derickson, 2012).

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IMAGE SOURCES

Fig. 1: NASA image of Hurricane Katrina 2nd landfall.
http://earthobservatory.nasa.gov/NaturalHazards/natural_hazards_v2.php3?img_id=13082

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A.I.S.Re.

ASSOCIAZIONE ITALIANA DI SCIENZE REGIONALI

Sezione Italiana della Regional Science Association International

XXXVII Conferenza scientifica annuale AISRe

"Quali confini? Territori tra identità e integrazione internazionale"

Ancona (AN), 20-22 Settembre 2016

L'obiettivo specifico della XXXVII Conferenza AISRe è orientare lo sforzo della ricerca scientifica nell'ambito delle Scienze Regionali verso temi di particolare rilevanza per il superamento degli attuali confini politico-amministrativi del territorio, attraverso la valorizzazione delle singole identità, il potenziamento del processo di integrazione, in un'ottica di proiezione internazionale.

L'idea fondamentale è di rivedere un paradigma di sviluppo territoriale, già ampiamente studiato nell'ambito delle Scienze Regionali come pianificazione di area vasta, che focalizzi nuovi aggregati indirizzandosi verso ambiti che travalicano i tradizionali confini, come nel caso dei progetti di razionalizzazione delle autonomie locali, dei gruppi di popolazioni che condividono analoghi problemi di carattere operativo-funzionale o degli ambiti territoriali cointeressati alla gestione ottimale di particolari risorse, eventualmente legate a specifiche condizioni geomorfologiche.

La fase storica attuale fornisce una molteplicità di evidenze che coinvolgono ambiti eterogenei a tutti i livelli di scala territoriale, fusioni dei comuni, città metropolitane, macro regioni nazionali ed europee. Per ciascuno di questi contesti l'aspetto fondamentale è rappresentato dalla rinnovata necessità di individuare nuove traiettorie di sviluppo che appaiono fortemente connesse a nuove politiche basate su una rielaborazione dei criteri di autonomia.

Il coordinamento ottimale, sia delle istituzioni che delle risorse già esistenti, permetterebbe il superamento dei possibili rapporti conflittuali tra i diversi attori coinvolti ed il superamento di disomogeneità potenzialmente dannose perché in grado di creare condizioni di diversità e disparità.

Ulteriore elemento di particolare interesse, inoltre, è la necessità di operare senza il supporto di specifici finanziamenti ad hoc, trasformando un potenziale elemento di debolezza in un fattore innovativo, perché l'assenza di risorse specifiche previene ogni possibile conflitto distributivo tra gli attori stimolando la ricerca di coordinamento e sinergia delle diverse fonti finanziarie esistenti sui diversi livelli coinvolti.

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CITIES AT RISK: STATUS OF ITALIAN PLANNING SYSTEM IN REDUCING SEISMIC AND HYDROGEOLOGICAL RISKS

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ABSTRACT

Italy and its urban systems are under high seismic and hydrogeological risks. The awareness about the role of human activities in the genesis of disasters is achieved in the scientific debate, as well as the role of urban and regional planning in reducing risks. The paper reviews the state of Italian major cities referred to hydrogeological and seismic risk by: 1) extrapolating data and maps about seismic hazard and landslide risk concerning cities with more than 50.000 inhabitants and metropolitan contexts, and 2) outlining how risk reduction is framed in Italian planning system (at national and regional levels). The analyses of available data and the review of the normative framework highlight the existing gaps in addressing risk reduction: nevertheless a wide knowledge about natural risks afflicting Italian territory and an articulated regulatory framework, the available data about risks are not exhaustive, and risk reduction policies and multidisciplinary pro-active approaches are only partially fostered and applied.

KEYWORDS:
Risk reduction; Italian Cities; Planning; Seismic risk; Hydrogeological risk.

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城市正面临风险：意大利规划系统在降低地质和水文灾害风险中的地位

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摘要

意大利及其城市系统正面临严重的地质和水文灾害风险。人们从科学讨论的角度意识到了人类活动在《创世纪》灾难中的作用，同时也认识到城市和区域规划在降低风险中的作用。本文综述了意大利遭遇水文和地质灾害的主要城市：1）推测了在拥有超过五万居民和大型城市环境的意大利城市中所发生地质和滑坡灾害的数据和地图。2）强调了意大利规划系统中灾害减少的原因（基于国家和地区层面）。对可用数据的分析和对规范性框架的综述都突出了在对降低灾害风险的探求中存在着空白。然而，不论是认识到侵扰意大利边境的自然灾害，还是认识到一个清晰的监管框架和可用的灾害数据都并不详尽，只有部分培养降低风险的政策和运用积极的多学科的方法才能减少灾害的发生。

关键词：
降低风险；意大利城市；规划；地质灾害；水文灾害.

1 INTRODUCTION

The Italian territory is inherently fragile, with a strong propensity to earthquake, landslides and floods. Special morphological conditions are amplified by land consumption and abandonment, a not incisive planning system, spread unauthorised urbanizations.

Around 2% of the total population of the country lives in areas with high landslide hazard, and 3% in areas with high flooding hazard[1] (Trigila et al., 2015).

The percentage rises to 41% for seismic hazard[2]. These threats involve also Italian urban systems: the ancient and recent history of several Italian cities is a history of reconstructions (Gisotti, 2012; Guidoboni & Valensise, 2014). This contribution reviews the state of Italian major cities referred to hydrogeological and seismic risks.

Academic and scientific literature provides many definitions of "risk" and "disaster risk", expressed as product of several components, such as likelihood of hazard, occurrence of a certain magnitude, effects on human and natural systems, vulnerability, exposure to hazards, preparedness and loss mitigation, resilience (Paul, 2011).

The main determinants of risks are commonly and globally identified in hazard, vulnerability and exposure[3]. The history of cities has been influenced by the necessity of defence and security from hazards (both human and natural ones) since their foundations.

The mutations lived by human societies since the XIX century have offered larger possibilities to overcome and control natural events. Regarding the protection from earthquakes, floods or landslides ("acts of god"), forms of mitigation, prevision and prevention through technological solutions have been the principal approach to face "natural" hazards.

Research on disaster reduction has progressively enlightened the role of human activities in provoking disasters, exacerbating natural hazards by increasing vulnerability and exposure of human settlements (Ambraseys & Bilham, 2011; Steinberg, 2000; UN World Commission on Environment and Development, 1987). Nonetheless, the necessity of reducing vulnerability and exposure achieving a larger resilience of territorial and urban systems raises in the debates mostly only after ruinous events (Guidoboni & Valensise, 2014; Menoni, 2005) and mainly to answer to general requests of "greater safety".

Security can be defined as a dynamic non-event, using Karl Weick's words: "dynamic" because requires constant adaptation and control; "not-event" because to be safe implicitly means to avoid an event or its consequences.

Consequently, a safe condition is not static, but it is the result of continuous works influenced by changing cultural references (Hollnagel, Woods, & Leveson, 2006; Menoni, 2005).

In fact, the process of building knowledge from unawareness and unknown emergencies to clarification and information about a known danger is filtered by cultural frameworks and collective perceptions (Alexander, 2014).

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1 Areas with "high" or "very high" level of landslide hazard (coded as zones P3 and P4 according to the plans for hydrogeological systems – PAI) and with "high" level of flooding hazard (coded as zone P3 according to the D.Lgs. 49/2010) for the implementation of the European Floods Directive 2007/60/EC) (Trigila, Iadanza, Bussettini, Lastoria, & Barbano, 2015, pp. 9-10, 37, 72, 110).

2 Elaboration of the author. Data refer to Istat census 2011 (http://dati-censimentopopolazione.istat.it/Index.aspx) and to areas with "high" or "medium" level of seismic hazard (coded as zones 1, 2, 2A and 2B. The list of Italian municipalities classified according to micro-zone classification is available at http://www.protezionecivile.gov.it/jcms/it/classificazione.wp updated to March 2015).

3 "*Disaster risk* signifies the possibility of adverse effects in the future. It derives from the interaction of social and environmental processes, from the combination of physical hazards and the vulnerabilities of exposed elements. [...] *Hazard* refers to the possible, future occurrence of natural or human-induced physical events that may have adverse effects on vulnerable and exposed elements. [...] *Exposure* refers to the inventory of elements in an area in which hazard events may occur. [...] *Vulnerability* refers to the propensity of exposed elements such as human beings, their livelihoods, and assets to suffer adverse effects when impacted by hazard events" (IPPC, 2012, p. 69).

Catastrophes are examples of events that affect cultural references fostering changes in law and regulation. From this perspective, the role of urban and regional planning as technical and legislative tool for risk prevention has emerged in debates and practices, as demonstrated by national and international studies and experiences, and by the update of laws and practices[4].

The awareness that the city is a complex relational system, consisting of interacting parts and multiple levels of organizations, leads to the necessity of non-sectorial risk reduction in urban environments. Increased safety is not derived from the sum of the safety of the individual parts (a concept well expressed by the notions of direct damages and induced effects) but it is the result of interrelated mechanisms involving the entire urban system, both in its physical and functional aspects.

The importance of planning follows consequently, given its multidisciplinary nature and role in the government of cities (Cremonini, 2009; Davoudi, Crawford, & Mehmood, 2009; Fera, 1991; Menoni, 2005; Pirlone, 2009). According to Esteban and colleagues, planning is a structural and non-structural long-term mitigation measure in reducing exposure and vulnerability of built environment (Esteban et al., 2011, pp. 132-111).

Inspired by Latour's thinking about modernity and "symmetric anthropology" (Latour, 1991),and by the idea that risk mitigation constitutes a public good (Reddy, 2000, as quoted by Menoni et al., 2011, p. 288), the paper examines hydrogeological and seismic risks in Italian major cities, and how risk reduction is framed in Italian planning system.

2 METHODS

Reports compiled by public agencies or leading research centres offer information and data about hydrogeological and seismic criticality (AA.VV., 2007, 2014; ANCE & CRESME, 2012; Ministero dell'Ambiente e della Tutela del Territorio e del Mare, 2008; Munafò et al., 2015; Trigila et al., 2015).

Data are provided at regional or provincial level maximum, without sub-classification, or focused on specific cities as samples.

The only exception is last ISPRA report n°233 (Trigila et al., 2015) providing data about landslides and floods at municipal level.

To extract detailed data about risks involving Italian cities and metropolis, the author developed specific analyses focusing on municipalities with more than 50.000 and 200.000 inhabitants[5] and on "metropolitan cities"[6], starting from OECD's definitions of "city".

OECD describes as "urban" a functional area with a population of 50.000 people at least. If the population is between 200.000 and 500.000 people, the urban area is defined "medium-sized".

Higher populations give birth to metropolitan areas (OECD, 2012).

Data about seismic risk are provided firstly through the selection of municipalities with a "high" or "medium" level of seismic hazard according to the national seismic micro-zoning[7]. For these cities, residential buildings built before anti-seismic building standards (L.64/74) have been highlighted[8].

[4] For further readings, also about the ancient experiences and practises of anti-seismic planning and urban design: Fera, 1991; Guidoboni, 2014.

[5] Data about administrative boundaries and 2011 population census have been downloaded from ISTAT website (http://www.istat.it/it/archivio/104317).

[6] According to the current legislation, Italian "metropolitan cities" are: Bari, Bologna, Florence, Genoa, Milan, Naples, Reggio di Calabria, Rome, Turin, Venice. The territory of every metropolitan city corresponds to the Province's one (L. 56/2014).

[7] Zones 1, 2, 2A and 2B of national micro-zone classification. See also note 2.

[8] ISTAT census offers data about the period of construction of residential buildings. Consequently, selected data concern buildings pre-1970s, structures hypothetically more vulnerable to earthquakes by comparison with the most recent ones.

Data about hydrogeological risks are provided extracting information from the appendix of 2015 ISPRA report (Trigila et al., 2015). The selection was focused on population and "urbanized surfaces" exposed to "high" or "very high" landslide hazard and "high" flooding hazard[9].

The study is also supported by a concise reconstruction of the historical evolution and principal contents of national and regional regulations about planning and risk reduction (in force at the moment of writing), starting from the beginning of XX century.

The aim was to analyse how the role of urban and regional planning as tools for risk prevention is framed in the Italian case.

3 ITALY: WHY A FRAGILE TERRITORY?

Italy is one of the most earthquake-prone countries in the Mediterranean, due to its geographical position, in the area of convergence between the African and the Eurasian tectonic plates.

Since the beginning of XX century, 30 strong earthquakes with a magnitude superior to 5.8 have struck Italy[10].

The complex orography predisposes the territory also to hydrogeological instability: Italian watersheds are generally small in size, and therefore characterized by extremely fast response to rainfall.

These peculiar morphological and geological conditions are amplified by forms of land consumption[11], the abandonment of mountain areas and deforestation, a not incisive planning system, spread unauthorised urbanizations, the lack of restoration and maintenance of slopes and watercourses.

A synthetic portray of the territory follows.

In Italy there are around 529.000 landslides: high landslide hazards concern 8% of Italian territory and around 1.224.000 inhabitants. More than 12.000 sq. km are subject to high hydraulic hazard: 4% of the territory for 1.915.000 inhabitants (Trigila et al., 2015).

Percentages rise referring to high seismic hazard, which concerns around 45% of the national surface and more than 24 million inhabitants (41% of the total population)[12].

Consequently, Italy has a very high vulnerability (due to the structural fragility of housing, infrastructures and industrial structures) and high exposure (for population density and historical and artistic heritage).

These hazards involve not only rural or mountain areas but also Italian urban systems. Ancient and recent history provide many examples of Italian cities struck by earthquakes, landslides or floods[13].

The demand for specific research about cities derives from the urban population at the present day: around 30% of Italian inhabitants live in cities or metropolis (with reference to the mentioned threshold of 50.000 inhabitants and to the legislative definition of metropolitan city).

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9 In ISPRA report, the estimation of the population at risk was performed by intersecting areas with maximum hydrogeological hazard (zones P3 and P4) with 2011 census sections. The indicator about "artificial surfaces" at risk was developed with a cartographic overlap between hazard maps and land consumption maps (Trigila et al., 2015, pp. 68-69). See also note 1.

10 Data from the National Institute for Geophysics and Volcanology. https://ingvterremoti.wordpress.com/i-terremoti-in-italia/.

11 According to ISPRA's data, about 9% of land consumption in Italy involves areas threatened by hydraulic hazards (Munafò et al., 2015, p. 29).

12 For definition of hazard levels, and information on data about seismicity, see notes 1 and 2.

13 For instance, since XI century, dozens of cities have been hidden by an earthquake with an intensity value of VIII or above on Mercalli scale (Guidoboni, 2014); for historical data about hydrogeological disasters, see: Gisotti, 2012; Guidoboni & Valensise, 2014.

	CITIES AND POPULATION	MEDIUM/HIGH SEIMIC RISK		HIGH/VERY HIGH LANDSLIDE RISK		HIGH FLOOD RISK	
7		num. of seismic cities, related population and residential building stock		num. of cities subject to landslides, related population and urban surface		num. of cities subject to floods, related population and urban surface	
Municipalities with more than 50.000 inh.	*141 cities*	67 cities		91 cities [B]		124 cities [E]	
	19.986.649 inh.	9.663.834 inh.	39% of national population subject to seismic hazard 16% of national population	188.651 inh. in areas subject to landslide	1.4% of population of [B] 15.4% of national population subject to landslides	656.016 inh. in areas subject to floods	3.5% of population of [E] 34% of national population subject to floods
		700.335 pre-1970 residential buildings	54% of building stock of seismic cities	31.5 urbanized sq. km. in areas subject to landslide	7% of Italian urbanized surfaces subject to landslides	149.8 urbanized sq. km. in areas subject to floods	22% of Italian urbanized surfaces subject to floods
Municipalities with more than 200.000 inh.	*16 cities*	4 cities		11 cities [C]		16 cities [F]	
	9.642.273 inh.	4.773.903 inh.	19% of national population subject to seismic hazard	86.045 inh. in areas subject to landslide	1.2% of population of [C]	236.065 inh. in areas subject to floods	2.4% of population of [F]
			8% of national population		7% of national population subject to landslides		12% of national population subject to floods
		173.916 pre-1970 residential buildings	60% of building stock of seismic medium-size cities	7.4 urbanized sq. km. in areas subject to landslide	1.5% of Italian urbanized surfaces subject to landslides	30.4 urbanized sq. km. in areas subject to floods	4.5% of Italian urbanized surfaces subject to floods
Metropolitan Cities	*10 metropolitan cities*	5 metropolitan cities [A]		8 metropolitan cities [D]		10 metropolitan cities [G]	
	17.789.075 inh.	7.172.934 inh. in seismic sub-municipalities	75% of population of [A]	273.950 inh. in areas subject to landslide	2% of population of [D]	541.015 inh. in areas subject to floods	3% of population of [G]
			29 % of national popul. subject to seismic hazard		22% of national population subject to landslides		28% of national population subject to floods
			12% of national population				
		408.243 pre-1970 residential buildings in seismic sub-municipalities	37% of building stock of seismic metropolitan cities	71.2 urbanized sq. km. in areas subject to landslide	15% of Italian urbanized surfaces subject to landslides	138.8 urbanized sq. km. in areas subject to floods	21% of Italian urbanized surfaces subject to floods
Italy	*59.433.744 inh.*	*24.513.924 inh. living in areas subject to earhquakes*	*41% of national population*	*1.224.001 inh. living in areas subject to landslide*	*2.1% of national population*	*1.915.236 inh. living in areas subject to floods*	*3.2% of national population*
				476.3 urbanized sq. km. in areas subject to landslide	*2.7% of national urbanized surfaces*	*673.3 urbanized sq. km. in areas subject to floods*	*3.8% of national urbanized surfaces*

Tab.1A Italian cities at seismic and hydrogeological risks. Data about population and buildings refer to ISTAT census 2011. Data about hydrogeological hazard are extrapolated by Trigila et al., 2015[14]

[14] For further details, see notes 1 and 2.

Table 1A provides detailed data about cities and population exposed to hydrogeological and seismic hazards. Table 1B offers disaggregated data for each major municipality and metropolitan city. The map illustrates the geographical distribution of the results, making also feasible a visualization of the overlaps existing among different hazard in the same urban context (Fig. 1).

	MEDIUM / HIGH SEISMIC RISK		VERY HIGH / HIGH LANDSLIDE RISK		HIGH FLOOD RISK	
Municipalities with more than 200.000 inh. and Metropolitan Cities	Inhabitants (% of population in municipalites at risk)	% of residential building stock pre-1970	Population in areas at risk (% on the total)	% of urbanized surfaces in areas at risk	Population in areas at risk (% on the total)	% of urbanized surfaces in areas at risk
Rome	2.617.175	53%	375 (0,01%)	0,01%	21.102 (0,8%)	2,7%
Rome Metrop. City	3.576.655 (89%)	37%	18.926 (0,5%)	0,6%	40.644 (1%)	2,3%
Milan	-	-	-	-	29.711 (2,4%)	2,4%
Milan Metrop. City	-	-	-	-	43.703 (1,4%)	1,3%
Naples	962.003	68%	45.943 (4,8%)	3,3%	226 (0,02%)	0,1%
Naples Metrop. City	2.793.510 (91%)	46%	101.000 (3,3%)	3,3%	28.817 (0,9%)	0,9%
Turin	-	-	530 (0,1%)	0,1%	1.350 (0,2%)	0,4%
Turin Metrop. City	-	-	29.772 (1,3%)	3,2%	31.142 (1,4%)	2,9%
Palermo	657.561	66%	5.663 (0,9%)	1,9%	8.394 (1,3%)	1,3%
Genoa	-	-	29.769 (5,1%)	6,9%	49.165 (8,4%)	6%
Genoa Metrop. City	-	-	68.734 (8%)	14,7%	86.658 (10,1%)	5,7%
Bologna	-	-	412 (0,1%)	0,6%	3.964 (1,1%)	1,2%
Bologna Metrop. City	148.890 (15%)	11%	15.664 (1,6%)	4%	92.211 (9,4%)	13,6%
Florence	-	-	1.570 (0,4%)	0,5%	12.121 (3,4%)	3,3%
Florence Metrop. City	86.357 (9%)	11%	22.186 (2,3%)	4,5%	51.051 (5,2%)	4,6%
Bari	-	-	339 (0,1%)	0,1%	1.506 (0,5%)	1%
Bari Metrop. City	-	-	3.635 (0,3%)	0,1%	14.827 (1,2%)	1,5%
Catania	293.902	69%	213 (0,1%)	0,04%	480 (0,2%)	2,7%
Venice	-	-	-	-	55.650 (21,3%)	8,4%
Venice Metrop. City	-	-	-	-	135.381 (16%)	13,9%
Verona	-	-	-	-	12.338 (4,9%)	3,4%
Messina	243.262	64%	697 (0,3%)	0,5%	1516 (0,6%)	0,8%
Padua	-	-	-	-	38.358 (18,6%)	16,5%
Trieste	-	-	534 (0,3%)	0,2%	103 (0,1%)	0,2%
Taranto	-	-	-	-	81 (0,04%)	1,4%
Reggio di Calabria Metropol. City	550.967 (100%)	59%	14.033 (2,5%)	2%	16.581 (3%)	4,2%

Tab. 1B Disaggregated data about Italian major cities and metropolitan cities

Fig. 1 Municipalities with more than 50.000 inhabitants, with high hydrogeological and seismic criticalities (elaborated by the author)

4 THE ROLE OF PLANNING

Research on risk reduction has recognised the role of regional and urban governance and planning in influencing the levels of risks, reducing or exacerbating natural hazards through infrastructural and technological measures, specific urban design technics, building codes, land-use plans etc. (Cremonini & Galderisi, 2007; Esteban et al., 2011; Fera, 1991; Menoni, 2005).

Given the levels of risk of Italian cities and metropolis clarified above, and the role of human activities in influencing such levels, the paper focus on how the reduction of seismic and hydrogeological risks is framed in Italian urban planning system.

Recognizing in legislation an element of risk governance (Esteban et al., 2011), a synthetic reconstruction of national and regional planning legislation has been carried out.

4.1 NATIONAL LEGISLATIVE FRAMEWORK

With reference to Italian history, many calamities have given birth to accusations of failures in territorial governance, leading towards new laws (or revisions of existing ones) in the direction of stricter rules and standards. First principal laws addressing the problem of stability of urban centres date back to the first decade of '900 (L. 445/1908; R.D. 193/1909); these acts introduced rules for the consolidation of landslides threatening villages, for the transfers of settlements and the prohibition of new constructions upon unstable lands.

The current national law on urban planning, promulgated in 1942 (L. 1150/1942), was modified and integrated in 1967 to achieve a larger control on urban development.

This legislative reform was influenced by the catastrophic events of 1966: the landslide in Agrigento and the floods in northern and central Italy (L. 765/1967).

In between the '70s and '80s, the relationship between seismic and hydrogeological risks and planning activities became direct, introducing special technical standards to build in seismic zones and requiring geomorphological judgements for urban plans (judgements necessary both to verify existing plans, both to adopt new ones) (L. 64/1974; L. 741/1981; D.M. 11 marzo 1988)[15].

The flood of Florence gave birth to twenty-year work of the De Marchi Commission, which introduced a national program of interventions and criteria for land protection and led to the law for land defence in 1989 (L. 183/1989)[16].

This law represented the first attempt to introduce an integrated approach among soil, water and planning, through "basin management plans"; this act was not effectively applied until the end of '90s, when the landslides in Sarno (1998) and the flood in Soverato (2000) led to the rapid enactment of laws both for the prevention of hydrogeological risk (imposing a national mapping of landslide risk), both for the implementation of basin management plans (L. 267/1998; L. 365/2000).

The indications given through these plans prevail on local urban plans.

After the earthquake in Umbria and Marche, a most appropriate concept of anti-seismic prevention has been imposed, not limited to the buildings but extended to urban centres[17]; after the earthquake in Molise, the technical

[15] The law 64/1974 imposed a verification of geomorphological compatibility of new town plans for municipalities belonging to seismic zones; after Irpinia's earthquake, the law 741/1981 attributed to Regions the power to establish rules and criteria for the update of existing planning instruments.

[16] The Environmental Code (L. 152/2006) unifies the legislation about land defence incorporating also the European Directive on water (2000/60/EC), while the European Floods Directive (2007/60/EC) has been implemented in 2010 (D.Lgs. 49/2010). The last one proposes a more comprehensive policy addressing flood risk, considering structural measures aimed at hazard control, but also vulnerability reduction.

[17] The law 61/1998 tried to introduce integrated programs of recovery aimed at rehabilitation and recovery of towns hit by earthquakes or exposed to hydrogeological hazards. Umbria regional law on planning is one of the most advanced in Italy, as detailed below.

building codes and the national seismic zoning of the territory were updated (O.P.C.M. 3274/2003), stating that the nature of the soil affects the seismic motion, influencing local seismic risk.

The same regulation imposed a revision for the town plans of municipalities which seismic classification was changed. In September 2008, guidelines for seismic micro-zoning were defined with the purposes of contributing to local knowledge and of reducing seismic risk providing criteria for planning (ANCE & CRESME, 2012; Ghirotti, 2014; Gisotti, 2012).

After Abruzzo's earthquake, special funds have been designated to a national plan for the prevention of seismic risk, and the national civil protection is in charge of the application of the law (L. 77/2009): in such process, the ordinance of the Chief of National Civil Protection n°52/2013 added the analysis of C.L.E. "Limit Condition for Emergency" as a compulsory examination to be joined to micro-zoning.

The study of C.L.E. is dedicated to strategic buildings and infrastructures, in order to achieve greater integration among intervention aimed at reducing seismic risk. The regulatory framework is summarized by Fig. 2.

4.2 REGIONAL LEGISLATIVE FRAMEWORK

Since the early '70s, several reforms dedicated to administrative functions and local governance have taken place in Italy: a crucial change in the system is recognizable in the concurrent legislative power on territorial governance conferred to Regions by the reform of the Title V of the Constitution in 2001[18].

Therefore, urban planning is regulated also at the regional level according to laws, principles and practices specific for each Region. By laws 64/1974 and 741/1981, Regions had to define rules and criteria to prevent seismic risks both for future town plans and detailed plans, both for the update of the existing ones.

The implementation carried on by Regions has been criticized, because of temporal delay in the enactment or the weakness of contents not able to influence urban planning (Menoni, 2005).

Otherwise, some of the most recent regional regulations have been able to better correlate prevention, risk reduction and design of planning tools (Monaco & Monaco, 2012).

The author developed a first examination of regional laws, focusing both on general laws on planning, both on specific laws on natural risks.

Analysing the principles stated, different approaches to risk reduction can be distinguished: only few Regions make no reference to the concepts of natural hazards or risks in their general laws on the government of territory (as the cases of Abruzzo, Lazio, Marche, Puglia, Sardinia).

In the majority of Italian Regions, basilar principles and notions on these themes have been metabolized from overriding national laws and debates, consequently achieving space in local laws on the government of territory (as the cases of Liguria and Piedmont[19]) or adopting specific regulations influencing local planning system (as the cases of Abruzzo[20], Marche, Molise, Puglia, Sicily, Valle d'Aosta).

Eight Regions out of twenty have clearly defined the reduction of risk as one of the focal objectives of territorial and urban planning in their main legislative framework: Calabria, Campania, Emilia-Romagna, Lombardy, Autonomous Provinces of Bolzano and Trento, Tuscany, Umbria, Veneto. Table 2 offers a synthetic overview of the regional framework.

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[18] The 2001 reform has brought to a division and partial overlay of competences about planning and environmental protection among different public bodies (L.C. 3/2001).

[19] The L.R. 56/1997 has been updated by the L.R. 3/2013, inserting references to co-planning activities, due to the necessity of cooperation with the Agency of the management of Po river basin. The Region has adopted also two specific deliberations about planning, seismic prevention and land defence.

[20] According to the L.R. 28/2011 of Abruzzo, art.3: the instruments of regional and urban planning contribute to seismic risk reduction, through analysis of hazard, vulnerability and exposure, and addressing the locational choices and processes of urban transformation in accordance with criteria of prevention and mitigation of seismic risk. The contents of the emergency plans are received in the municipal urban planning tools.

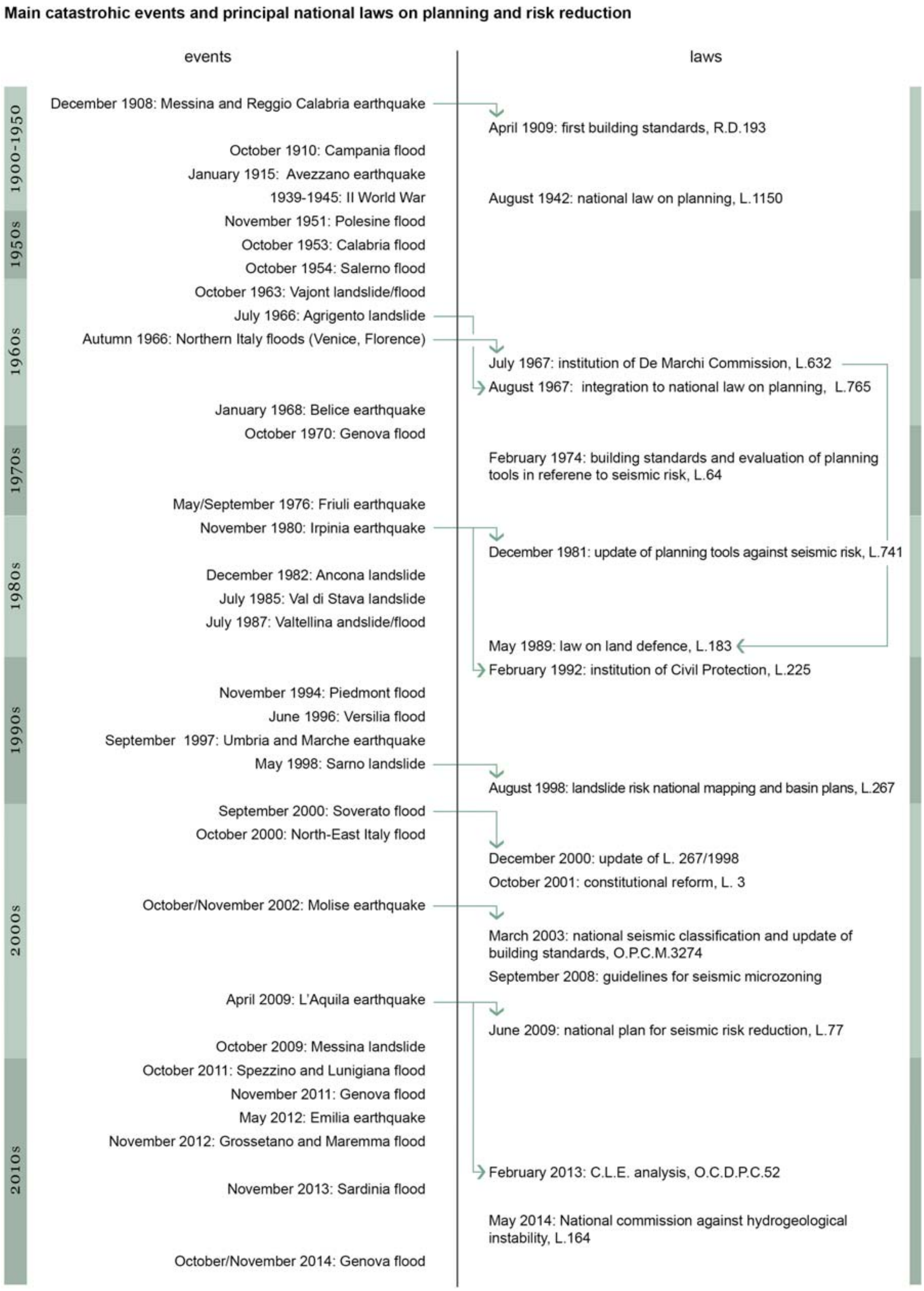

Fig. 2 Main catastrophic events in Italy since the beginning of XX century, and the regulatory framework influencing risk reduction and planning. Arrows indicate direct relations between events and promulgation of law

	REGIONAL LAW ON GOVERNMENT OF TERRITORY	REGIONAL SPECIFIC LAWS FOR RISK REDUCTION
Abruzzo	18/1983	28/2011
Basilicata	23/1999	38/1997; 25/1998
Calabria	19/2002	35/2009
Campania	16/2004	9/1983; 21/2003
Emilia-Romagna	20/2000	19/2008
Friuli-Venezia Giulia	5/2007	16/2009
Lazio	38/1999	4/1985
Liguria	36/1997	29/1983
Lombardy	12/2005	*abolished by the general regional laws*
Marche	34/1992	33/1984; 22/2011
Molise	-	15/1986; 25/2011
Piedmont	56/1977	19/1985; Regional Resolutions 540/2012 and 64/2014
Puglia	20/2001	Regional Resolutions 1328/2007 and 2753/2010
Sardinia	45/1989	-
Sicily	- *(temporal law: 71/1978)*	Regional Circular 2222/1995
Tuscany	65/2014	*abolished by the general regional laws*
Trentino-Alto Adige	Prov. Bolzano: L.P. 13/1997	Provincial Resolution 712/2012
	Prov. Trento: LP. 15/2015	DPR 15.01.2006
Umbria	1/2015	*abolished by the general regional laws*
Valle d'Aosta	11/1998	Regional Resolutions 2939/2008
Veneto	11/2004	Regional Resolutions 1841/2007 and 3308/2008

Tab. 2 List of regional laws on government of territory and examples of regional specific laws for risk reduction influencing planning (the laws indicated are in force at the moment of writing)

Some examples from the most interesting regional laws follow.
According to the regional law 19/2002 of Calabria, the Structural Municipal Plan regulates land use in relation to the assessment of the condition of landslide risk and local seismic hazard, and defines the areas necessary for the Civil Protection Plan (art. 20). The regional law 65/2014 of Tuscany requires both verifications on hazards related to hydrogeological aspects, coastal dynamics and seismicity during the design and updates of plans, both identification of the conditions that ensure the viability of the transformation proposed.
The law requires to update information about hazard and exposed areas after emergencies because they form the basis of regional and urban planning; the municipal plan of civil protection is an integral part of the town plan (art. 104). Umbria Region states that “anti-seismic discipline” is part of the activities involved in the government of territory at the art. 1 of its regional law on planning (L.R. 1/2015).
The town plan has to define architectural, functional and infrastructural elements (existing or planned) that constitute the “Minimal Urban Structure” (S.U.M.) whose efficiency has to be ensured for reducing urban seismic vulnerability (art. 21).

Veneto's regional resolution 3308/2008 stresses that in recent years "it is definitely gained the awareness of how seismic actions, combined with the design and construction of buildings not adequately compatible with the characteristics of the soil, make vulnerable both individual buildings and urban aggregations. For this reason, seismic issues have to be introduced in the procedures defined in the new regional planning framework, which has significantly changed the approach to urban planning".

This fragmented and complex legislative framework could be summarized from a temporal point of view: less recent regional laws on planning ignore issues about nature-driven risks, while laws defined or updates since the beginning of 2000s demonstrate a more advanced approach, closer to the debate about risk mitigation.

5 DISCUSSION

From the analysis of available data and legislative framework in force, the research highlights topics not adequately discussed in the debate about cities and risks and the different approaches and methods for reducing risks led by national and regional authorities.

5.1 MISSING ISSUES

The fragility of Italian territory is widely documented as shown by studies, reports and data available, as well as by dedicated national and local laws here summarized (among the others: (AA.VV., 2007, 2014; ANCE & CRESME, 2012; Guidoboni & Valensise, 2014; Ministero dell'Ambiente e della Tutela del Territorio e del Mare, 2008; Munafò et al., 2015; Trigila et al., 2015).

A deep knowledge about seismic and hydrogeological risks has been developed in Italy, and consequently rich and wide information. Nevertheless, missing elements and themes emerge, above all for what concerns urban systems. The availability of open-access data at local scale is only very recent[21].

This represent a consistent weakness of the attention dedicated to the issue of nature-driven risks in cities, considering that about 33% of Italian inhabitants live in municipalities with more than 50.000 inhabitants. In the same way, data are generally referred to hazards, and not frequently to an evaluation of risk as the product of hazard, vulnerability and exposure.

For what concerns the legislative framework about seismic and hydrogeological risk reduction, the evaluation and mitigation of hazards have been included in the national and regional legislation, and the role of planning activities in challenging these risks is recognized. In the meantime, high vulnerability of Italian territory and cities to "natural" hazards is demonstrated both by data, both by the ruinous effects of earthquakes and recurrent floods and landslides, as summarized by the chronology in Fig. 2.

To analyse the reasons of the state of decay of the territory is not the purpose of this study, but some considerations can be sketched. As Casagli and Menoni recognized, problems of inadequate implementation of the cited legislative frameworks, from a qualitative and/or quantitative point of view, can be a partial answer to Italian territorial fragility in its physical, social, economic and political aspects (Casagli, 2012; Menoni, 2005, p. 161).

This wide legislative framework has not efficiently influenced planning choices and collective history, and the upgrades in the normative systems have not triggered appropriate connection and coordination between laws and operational tools despite the regulatory constraints[22].

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21 As discussed before, only last ISPRA report n°233 offers an open-access dataset from which extrapolating data about cities. Generally, data are accessible only at regional or provincial scale.

22 For instance, the building regulation is dedicated mainly to reduce seismic risk and contains very few norms in terms of building resilience to hydrological processes. Many analysis, such as geological or seismic studies, were imposed more as formal acts than as actual bound conditions for planning strategies for land use. Soil stability is not affected only by new urbanization but also by many other ordinary interventions in the cities; consequently,

Risk reduction struggles to go beyond fragmented interpretations, regulations and plans, that debate about it as a topic in unstable balance between civil protection, planning and environmental protection[23]. An effective reduction of risks through planning is a systemic strategy, that takes into consideration the effects of territorial transformations on physical, functional, social and economic pillars of cities (Biondi, Fabietti, & Vanzi, 2011)[24].

Even if interconnections between "sector plans" and "general planning" are present at an early stage in the latest regional laws, they emerge clearly only in post-disaster reconstruction plans or programs (Monaco & Monaco, 2012), when integrating technical and political choices is likely recognised as the favoured strategy to reduce risks, maximise efforts and decrease costs[25].

The crisis of planning (Benevolo, 2012) and the pervasive phenomenon of illegal urban development[26] are well-known and have to be added to these issues, as well as the weakness of control activities, the inadequate expenditure for activities dedicated to prevention and reduction of existing risks (Amanti, 2014; Menoni, 2005).

The overlaps among different institutions and subjects appointed in activities of risk reduction can have led to a counterproductive fragmentation of roles and tools.

Furthermore, the research highlights also how these themes are not even present in some cases, as demonstrated by absent or obsolete regional laws on planning, or by a not sufficient debate at the national level.

5.2 NATIONAL AND REGIONAL POWERS

In the last years, legislative changes occurred at the national level, influencing the planning system too. The Italian parliament is discussing a bill for a new reform of the Italian Constitution (after the mentioned 2001 reform) at the moment of writing (DdL. 1429-D, 20th January 2016).

According to this proposal, "the general norms about the government of the territory and the national system of civil protection" will return to be subjects of the exclusive legislative power of the State.

The process in ongoing, but the proposal let arise many questions about if and how this change will affect local planning systems in all their aspects, which are deeply different in every Region, as showed through the previous examinations. Going back to the national law on urban planning (L. 1150/42), several proposal of reform have been suggested without accomplishment; the last one promoted in July 2014[27] was mainly a fiscal proposal, without any reference to broader meanings and roles of planning.

On the contrary, planning is largely recognized by the academic and scientific debate a discipline characterized by a holistic and proactive approach and involved in the overall government of cities, urban environment and landscape (Davoudi, 1999; Secchi, 2000), as proved by recent regional laws. Consequently, no reference is made in this proposal about the role of public territorial policies and urban transformation in the reduction of risks. The national debate on planning seems to lag behind the regional ones.

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geological studies at the base of a reliable local planning cannot be only analytical, but must be referred to new uses and projects proposed.

23 For example, the necessity of the spatial organization of civil protection and emergencies could be included in land use decisions, to regulate consistently the design of planning instruments.

24 Existing studies on the use of "Minimal Urban Structure" and "Limit Condition for Emergency" as categories for planning are examples (Fabietti, 2013; Olivieri, 2013).

25 For further readings about the role of urban planning in post-disaster reconstruction in Italy, among the others: Caravaggi, Carpenzano, Fioritto, Imbroglini, & Sorrentino, 2013; Clementi & Di Venosa, 2012; Olivieri, 2004.

26 According to Legambiente and CRESME, between 1998 and 2003 the medium percentage of not legal buildings is about 30% of total heritage (Legambiente, 2008, as cited by Destro, 2013, p. 83).

27 "Principles for territorial public policies and urban transformation", promoted by the Ministry of Infrastructures and Transports.

5.3 REACTIVE AND PROACTIVE APPROACHES

Examining the normative evolution, it's possible to affirm that Italian regulations propose an approach to the reduction of urban risks that can be described as still partially "reactive"[28] both at national and local level. The relation between urban planning and reduction of risk emerging from laws seems based on assessments of compatibility between proposals of future urban transformation and hydrogeological and seismic characteristics of the territory, assuming the knowledge of hazards and potential risks as a guide in designing planning.

This reactive approach has been traditionally predominant, even if in different forms. Regarding seismic risk, because of the impossibility of reducing the hazard, the reduction of vulnerability has been mainly delegated to an increase of structural resistance of buildings and infrastructures to hazards. On the contrary, regarding hydrogeological risks, the main approach has been the reduction of hazards when possible, such as intervening on hydrographic systems or on unstable areas.

In both cases, the main strategy was delegated to engineering technologies, standards, regulations, almost considering exposure as "irreducible".

Without denying the fundamental role of these methods, poor references to strategic and systemic approaches and to the spatial context represent recognized weaknesses (Cremonini & Galderisi, 2007). Surprisingly, examples of "reactive approach" can be found also in recent laws that in general propose more advanced positions on the theme, such as in Veneto's regional resolution 1841/2007 about hydrogeological risk: "Increased human pressure on natural resources often *forces to plan urban development in areas with high geological risk, thus forcing to tackle risks ever higher* [...] It's very important to demonstrate that new planning forecasts will not aggravate *the existing level of flood risk, nor will compromise the possibility of reducing that level* [...] the assessment of hydrogeological compatibility may also provide measures for risk mitigation, indicating their effectiveness in *reducing the hazard*" (translation of the author, italic added).

Other Regions propose a different attitude.

For instance, Umbrian regional law (L.R. 1/2015) imposes that new settlements proposed by town plans cannot use areas in the presence of a significant risk of flooding or landslides, in order to guarantee a sustainable land use; it also prescribes objectives and tools for the reduction of seismic urban vulnerability in town plans, integrating de facto prevention and planning activities[29]. Similarly, in Emilia Romagna (L.R. 20/2000) the structural town plan has to set out actions to eliminate or reduce the level of risk in existing settlements.

In territories characterized by hydrogeological instability, hydraulic danger or avalanches, only recovery interventions on existing buildings are allowed, while new constructions and land use changes that can augment the exposure to risk are prohibited.

These approaches can be read as steps towards pro-active ones, that look at the reduction of risk as a combination of activities to reduce hazards, vulnerabilities and exposure, with reference to cities as complex systems, not addressing single aspects.

Enlarging these reflections towards prevention activities, it is necessary an annotation about the relationship between urban planning and the activities of prevention and emergency management, carried out by the Civil Protection mostly.

This relationship is ruled by the national law (L. 225/1992) but also at the local level: generally, civil protection activities should be harmonized with the programs for territorial protection and recovery.

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28 Reactive approaches are defined as feedback-driven, based on resistance to changes. Proactive approaches are feedforward-driven, based on anticipation and adaptation. For further reading, among the others: Godschalk, 2003; Hollnagel et al., 2006; Klein, Nichollsb, & Thomallaa, 2003.

29 Umbria Region is considered exemplar for its attention to these issues after 1998 earthquake, for instance for its L.R. 61/1998 and its previous regional law on planning (L.R. 11/2005) (Di Salvo, Giuffrè, Pellegrino, & Pizzo, 2012).

A recent reform of Civil Protection System (L. 100/2012) has overturned this notion, imposing to the plans involved in government and protection of the territory to be coordinated with the emergency plans of civil protection, above all with local ones (art. 3).

For instance, Tuscany and Calabria's regional law on planning confer to town plans the contents and efficacy of emergency plans too; consequently, every update due to emergencies or to ruinous events constitute a direct variation of the town plans[30].

In the meantime, in the last twenty years the national expenditure for activities dedicated to prevention amounts to the 40% of the costs incurred to repair damages, less than the 1% of the expenditure potentially needed for a full recovery from the same events (Amanti, 2014) [31].

The shift from mitigation of risk to systematic reduction and adaptation to it is still at a first stage in the national debate, contrary to the international wide debate that fostered the diffusion of the concept of "urban adaptation" to risks, mainly inherited by the considerations about the notions of "urban resilience" and "climate change adaptation" (Biesbroek, Swart, & Van der Knaap, 2009; Davoudi et al., 2009)[32].

Besides, how to reduce risks and intervene on existing urban fabrics exposed to existing risks (and commonly built in dissimilarity to regulations), is a not raised question, which instead represents one of the most delicate and hard aspects of the theme.

As every process of urban transformation in built contexts, the reduction of risks have to be carried out through cross-sectorial activities (for instance, adaptation of housing stocks and infrastructures, urban retrofitting aimed at the recovery of open spaces, building redundant paths, changing uses and locations), confronting the necessity of transformation with inherited uses and activities, historical values and social significances of the city (Casagli, 2012; Fera, 1991; Lazzari, 1988; Monaco & Monaco, 2012).

6 CONCLUSION

Seismic and hydrogeological risks stress Italian territory, as showed by national and regional reports, events, thematic data. Through a selection of available data and an original extraction and synthesis of information from official reports, the paper proposes a synthetic profile of Italian cities and metropolis at seismic and landslide risk, to underline the wide dimension of the phenomenon.

Risk reduction can be a variable of planning, as recognized by the current scientific debate (Cremonini, 2009; Cremonini & Galderisi, 2007; Fera, 1991; Menoni, 2005; Menoni & Margottini, 2011) and given the increased awareness of the role of human activities in the genesis of disasters (Ambraseys & Bilham, 2011; Steinberg, 2000).

The review carried out by this research shows how the reduction of "natural" risks through planning has been influenced by catastrophic events, and how it is framed in national and regional normative frameworks, given that territorial governance is framed as a concurrent legislative power between State and Regions.

The paper highlights interesting recent steps towards more pro-active approaches as deducible by recent regional laws as Umbria's. Nevertheless, the fragility of the territory demonstrates the limits of these attempts, as suggested by the difficulties in fostering regular and systematic risk reduction policies, and in strengthening ordinary tools of land defence.

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30 In this sense, the introduction of the analysis of "Limit Condition for Emergency" mentioned previously can contribute to a deeper relation between planning, reduction of risk and civil protection activities.

31 Use of "states of emergency", and the related active role of Civil Protection, is often controversial: the declaration of a state of emergency allows to exceed ordinary regulations, such as general laws on public works.

32 Adaptation is a complex capacity, focused on adjusting systems to moderate the impact of potentially ruinous events; for instance, it can take the shape of reducing dependence on vulnerable systems, of decreasing sensitivity and exposure, of strengthening existing elements (Adger, Huq, Brown, Conway, & Hulme, 2003).

There is not a deep acknowledgement of risk reduction as a “public good” yet, as well as of the common relevant points shared by the purposes of reducing risks.

An effective land defence is a system of integrated policies addressed to long-term use and management of the territory, and not only to reduction of land consumption.

The government of territory should not be focused on introducing new restrictions or tools, but on coordinating existing ones in new and comprehensive integrated frameworks based on urban multi-risk analysis.

The role of planning as an ordinary tool of land defence has not been strengthened; it doesn’t seem able to shift urban development and design towards new paths, while to perpetuate “Weick’s non-event” requires constant effort.

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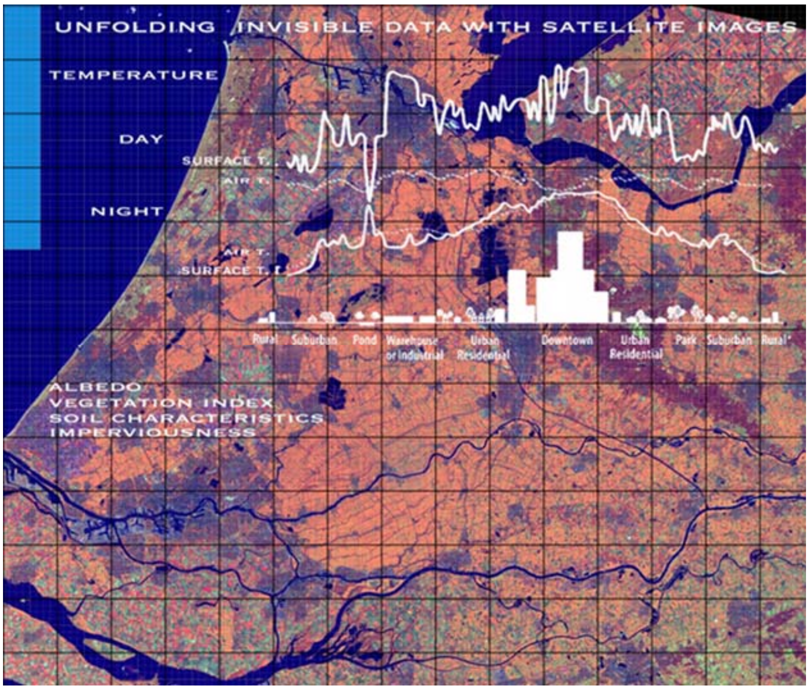

SURFACE THERMAL ANALYSIS OF NORTH BRABANT CITIES AND NEIGHBOURHOODS DURING HEAT WAVES

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ABSTRACT

The urban heat island effect is often associated with large metropolises. However, in the Netherlands even small cities will be affected by the phenomenon in the future (Hove et al., 2011), due to the dispersed or mosaic urbanisation patterns in particularly the southern part of the country: the province of North Brabant. This study analyses the average night time land surface temperature (LST) of 21 North-Brabant urban areas through 22 satellite images retrieved by Modis 11A1 during the 2006 heat wave and uses Landsat 5 Thematic Mapper to map albedo and normalized difference temperature index (NDVI) values. Albedo, NDVI and imperviousness are found to play the most relevant role in the increase of night-time LST. The surface cover cluster analysis of these three parameters reveals that the 12 "urban living environment" categories used in the region of North Brabant can actually be reduced to 7 categories, which simplifies the design guidelines to improve the surface thermal behaviour of the different neighbourhoods thus reducing the Urban Heat Island (UHI) effect in existing medium size cities and future developments adjacent to those cities.

KEYWORDS:
Urban Heat Island; Climate Change; Sustainable Urban Planning; Remote Sensing.

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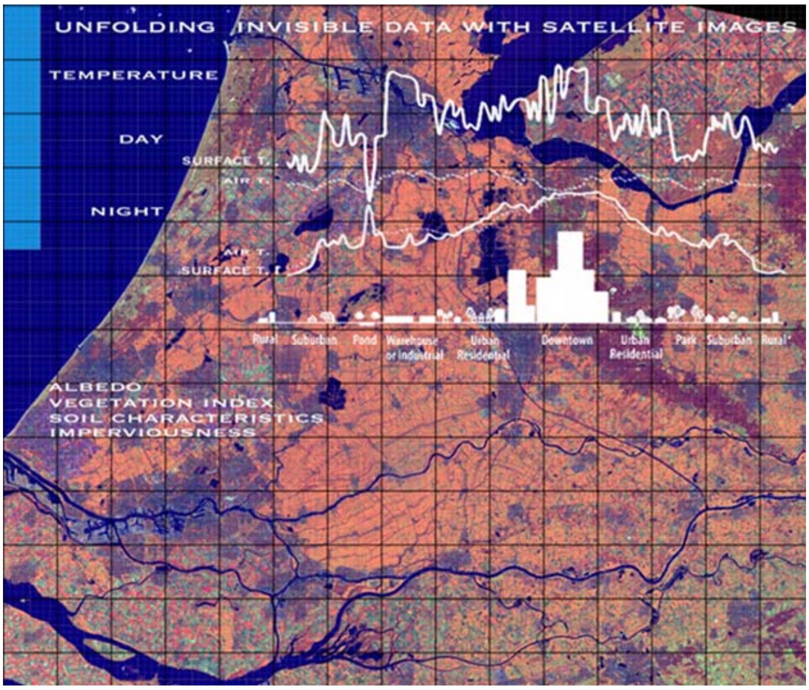

对遭遇热浪袭击的布拉班特省北部城市及其周边地区进行的地表热力分析

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摘要

城市热岛效应经常与大城市密切相关。然而，荷兰的城市大多是像南部的布拉班特省一样分散式或马赛克式的，这导致一些小城市都将在未来受到这种热岛效应的影响（Hove et al., 2011）。本研究通过 MODIS 11A1（搭载在terra和aqua卫星上的一个重要的传感器）传回的22幅关于2006年热浪的卫星图像和陆地卫星5号（Landsat 5）专题测图仪（Thematic Mapper）绘制的反射率和归一化温度指数（NDVI）值，研究分析了布拉班特省北部21个地区的夜间平均地表温度（LST）。研究发现，反射率、归一化温度指数（NDVI）值和不渗透性是导致夜间平均地表温度上升最有关联性的因素。通过上三个参数对地表覆盖聚丛的分析，体现出曾用于布拉班特省北部地区的12个“城市居住环境”类型可以减少到7类。这有利于简化设计指导方，提高周边地区的地表热力体现，减少中等城市的城市热岛效应，并促进毗邻城市未来的发展。

关键词:
城市热岛效应；气候变化；可持续的城市规划；遥感

1 INTRODUCTION

1.2 HEAT ISLANDS AND MEDIUM SIZE CITIES

The urban heat island (UHI) refers to the temperature difference between urban areas and their rural and/or natural surroundings. This temperature difference may affect the air temperature, the land surface temperature (LST) or both. Although the two are related, the difference is that while land surface temperature´s peak takes place during the day, the air temperatures differences are largest after sunset. The air temperature difference peak that is typically reached after sunset can reach up to 12ºC for a city of 1 million inhabitants (United Stated Environmental Agency). These relative high temperatures are especially problematic during heat waves and can easily result in heat stress among vulnerable segments of the urban population, leading to widespread mortality. Several climate studies show that even though The Netherlands may seem relatively safe from heat events due to its moderate maritime climate and its polycentric urban structure, it is actually also affected by heat events like those that took place in France in 2003 or in Russia in 2010 (Hove et al. 2011, Van der Hoeven F. and Wandl A. 2014, Albers et al., 2015). Many studies highlight the importance of developing and implementing urban planning measures to adapt our cities to climate change (Galderisi A. and Ferrara F.F., 2012; Papa R., Galderisi A., Vigo Majello M.C., Saretta E., 2015; Deppisch S., Dittmer D., 2015; Balaban O., Balaban M.S., 2015). The impact that heat islands can have on society has been studied in the last decade by several research groups (Stone B., 2012). A link was found between the night-time urban heat island as observed by satellites and the excess mortality in Paris during the heat wave of 2003 (Dousset et al., 2011). Other investigations showed that the urban heat island did have a measurable effect on aggravating the impact of the same heat wave event in Paris (Vandentorren et al., 2006). Similar conclusions were drawn in the case of London (Mavrogianni et al., 2011). In all of these cases the object of research is the large metropolis. Similar investigations into dispersed regional urbanization patterns are lacking.

North Brabant is a province located in the South and Center of the Netherlands. It is one of the biggest and most populated Dutch provinces. Due to its polycentric urban structure the Netherlands still has a relative high population density. The population that inhabits the Dutch towns and cities is ageing and becomes more vulnerable to heat. The four climate scenarios that are drawn up by the Royal Netherlands Meteorological Institute (KNMI) predict an increase of the global temperatures of at least 1 ºC (Van den Hurk B. et al., 2006) and predictions foresee an increased probability of summer heat waves (Sterl et al, 2008). The definition of a heat wave differs from country to country. In the Netherlands each period of at least five consecutive days with a maximum temperature above 25˚C, of which at least three days peak above 30˚C is registered as an official heat wave.

1.3 NORTH BRABANT: PARTICULAR MOSAIC URBAN STRUCTURE

In the context of urban heat the province of North Brabant is particularly interesting. The urban structure of NorthBrabant (2.5 million inhabitants, 500,000 ha) consists of a network of almost 300 small-size cities (urban cores in rural areas with surfaces below 900 ha) and some 60 midsize cities (urban concentration areas with surfaces below 8,000 ha) interleaved with rural and natural park areas. The overall percentage of urbanized land represents 15.4%. The future spatial vision of North Brabant region (Provincie Noord-Brabant, 2010) organizes the midsize cities in three clusters: the first one comprises the two most important agglomerations Tilburg (12,000 ha and 550,000 inhabitants) and Eindhoven (750,000 inhabitants), the second one which comprises a group of cities to the west: Bergen op Zoom, Roosendaal, Etten-Leur, Breda, Oosterhout, Waalwijk, ´s-Hertogenbosch and Oss (with sizes ranging from 12,900 ha in Breda to 5,590 ha in Etten-Leur) and the third category which consists of Uden (6,700 ha) and Veghel (7,900 ha), two former villages that have strongly grown in the last decade and that have a marked suburban and industrial character. The urban structure is considered as a network up to the point that the five most important cities of the region - Tilburg, Breda, ´s-Hertogenbosch, Eindhoven and Helmond - receive the name of Brabantstad, which means in Dutch as much as: Brabant City.

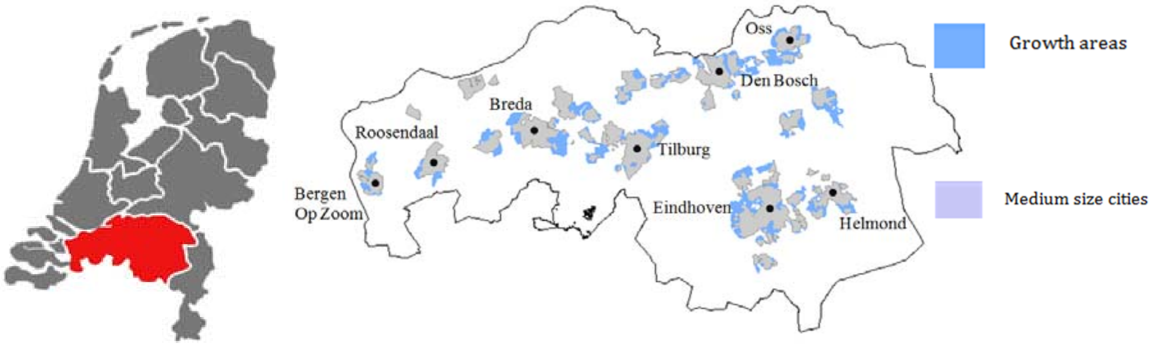


Fig. 1 Growth areas adjacent to medium-size cities

1.4 FUTURE EXPANSION PLANS OF THE REGION

The future spatial vision of North-Brabant (Provincie Noord-Brabant, 2010) foresees to enhance the spatial structure of the urban network through two different development prospects for small cities and for medium-size cities. The intention is to have midsize cities host regional urban infrastructures, as opposed to the small cities, which will inevitably play a role at a more local scale. In order to materialise the reinforcement of the urban network, the region of North Brabant has identified growth areas (in Dutch “zoekgebieden voor verstedelijking”) connected both to small and midsize cities (Provincie Noord-Brabant, 2014). These are rural areas, which will be converted into urban plots, connected to existing cities (figure 1). The Province plans to urbanise over 25,000 hectares of which roughly 17,000 ha are adjacent to midsize cities. Overall the future percentage of urbanised land will increase from 15.4% to 20.4%. The province of North Brabant is aware of the implications of increasing the urbanised areas, and has used the “ladder for sustainable urbanisation” developed by the Dutch Ministry of Infrastructure and Environment to compare the urban development needs with the options to restructure nearby derelict areas prior to delimiting the “growth areas”. However, the potential urban heat island aggravation produced by the growth of urban areas has not been taken into consideration.

1.5 RESEARCH QUESTIONS:

How can we ensure that future development plans do not aggravate the urban heat island effect in the province of North Brabant?

In order to answer this question we have formulated four sub questions:

- What is the extend of the current heat island problem in North Brabant?
- How does albedo, normalized difference vegetation index (NDVI), imperviousness, city size and proximity to other urban areas influence the phenomenon?
- Which of these play the most relevant UHI role?
- Can we establish a surface thermal urban classification to provide design guidelines to ensure that future developments do not aggravate the UHI phenomenon?

2 METHODOLOGY

2.1 DETERMINING THE ROLE OF DIFFERENT PARAMETERS IN THE FORMATION OF THE UHI IN THE REGION OF NORTH BRABANT

In the first section of the study we have mapped and calculated the average night-time land surface (LST) temperature (which has been calculated for 21 medium-size cities in the region of North Brabant with MODIS 11A1 images retrieved during the heat wave of 2006 in The Netherlands), albedo (calculated with Landsat 5TM imagery retrieved during the 2006 heat wave), NDVI (calculated with Landsat 5TM imagery retrieved during the 2006 heat wave), imperviousness coefficient (calculated using official Netherlands ArcGis files) and surface, and we have completed a multiple regression analysis to understand how each of these parameters affected the average night-time LST, and which of them played the most important role in the region of North Brabant. We have also used Excel´s dynamic charts to establish thresholds and reference figures for each of the analysed parameters.

2.1.1 NIGHT-TIME LAND SURFACE TEMPERATURE FROM JULY 2006 AS A KEY UHI INDICATOR

The spatial pattern of the daytime (LST) urban heat island differs often significantly from the spatial pattern of the night time (air temperature) urban heat island. However, the night-time air temperature and LST heat islands have strong correlations (Nichol J. 2005). The main exceptions are water surfaces. Because the cities in the province North-Brabant have relatively little open water, we can use night-time satellite imagery as a source of data for determining for the overall UHI effect. In this context we analysed the average night-time surface temperature of 21 midsize cities (with surfaces ranging from 117 ha to 7,700 ha) using 22 satellite images retrieved by Modis 11A1 during July 2006. July 2006 was the warmest month on record since systematic measurements started some 300 years ago in the Netherlands. The mean daily temperature in July 2006 was 22.3ºC, almost 5ºC higher than the average over the period of 1971-2000: 17.4ºC according to the Royal Netherlands Meteorological Institute (KNMI, 2006). Temperatures reached on July 19th 2006 a maximum of 35.7 ºC (KNMI, 2013). Statistics Netherlands published an article in its web magazine that states that 1,000 inhabitants died in July 2006 above the average mortality in a July month.Predeominatly in the western part of the country, by the way. Topography plays a significant role in many regions in the world when it comes to climate. Not so in the case of North-Brabant. North-Brabant is like much of the rest of the Netherlands: flat. The lowest parts in the western part of the province measure 1-2 metres above sea level. The highest parts in the east at a distance of 100 kilometres are 45 metres above sea level.

There is a lack of prevailing winds during heat waves. Heat waves emerge in the Netherlands predominantly under the condition of low or even lacking wind speeds. Problems with urban heat occur especially when there is no or little wind. For example, during the temperature peak on July 19th the KNMI measured wind speeds between 2.0-3.0 m/s^2, while in urban areas these wind speeds would be significantly lower due to the many buildings, trees and other obstacles. Temperature is the dominant factor here.

The data we used, MOD11A1, is a satellite imagery product issued by the Moderate Resolution Imaging Spectro-radiometer (MODIS), which has a resolution of 1,000 m and a daily temporal frequency. The images have been downloaded from the United States Geological Survey webpage. First, the average night time surface temperature for each of the medium size cities was calculated for each of the satellite images and afterwards the average value of all the heat wave satellite images retrieved during the heat wave. These two operations were performed using ArcGis.

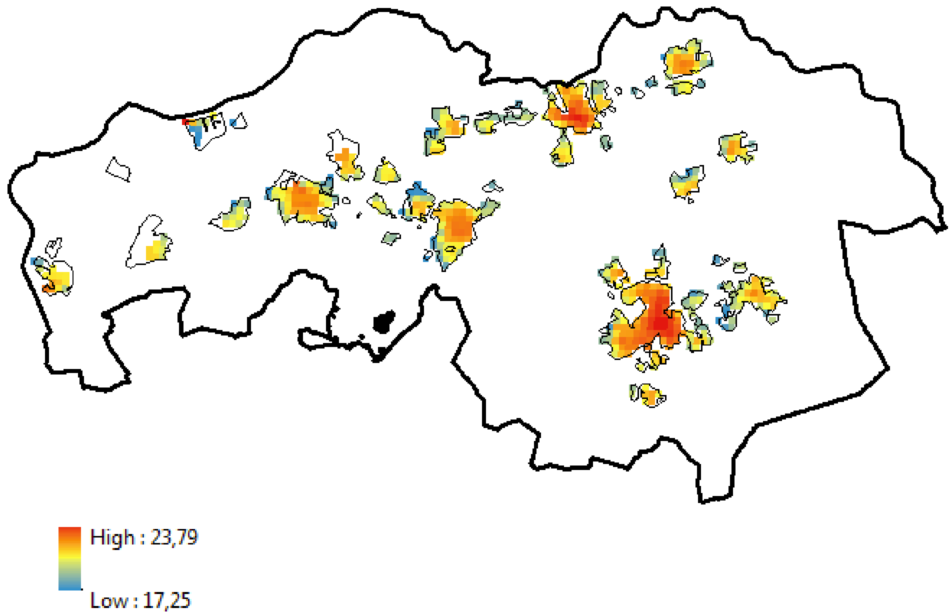


Fig. 2 Average night time LST urban areas of the province of North Brabant. LST values retrieved from Modis 11A1 imagery of the 23rd of July 2006

2.1.2 UHI-RELATED PARAMETERS ANALYSED

PARAMETERS RELATED THE URBAN DESIGN

Albedo, imperviousness and vegetation seem to be relevant parameters influencing the UHI. Several works have investigated the role of surface albedo in the UHI formation (Gao et al. 2014; Prado & Ferreira, 2005; Akbari et al. 2001; Taha 1997; Sailor 1995; Taha et al. 1992; Taha et al. 1988). Other studies have found a strong linear relationship between the land surface temperature (LST) and the imperviousness percentage and an inverse linear relationship between LST and the NDVI during the summer seasons (Nie & Xy 2014, Yu & Lu 2014; Heldens et al. 2013; Xu et al. 2012; Zhang et al. 2009; Weng & Lu 2008; Xiao et al. 2007; Yuan & Bauer 2007).

In this study we have used Landsat 5 TM satellite imagery from the 25th of July 2006 to calculate albedo and NDVI. We have downloaded the raw satellite images from the US Geological Survey (USGS) webpage, Earth Resources Observation and Science Center (EROS). For the albedo calculation, we have used software for satellite imagery atmospheric topographic correction called ATCOR 2/3 which allows not only to correct atmospherically the images but also to generate the corresponding albedo distribution image (Richter & Schlapfer, 2013) (figure 3). For the NDVI calculation we have first corrected Landsat 5 TM spectral bands 3 (visible) and 4 (near-infrared) – both with a 30 m resolution - in ATCOR 2/3 and we have further used a geospatial imagery treatment software called ENVI 4.7 to map the actual index, which is defined as (NIR-VIS)/(NIR+VIS), where VIS (visible radiation) is the surface reflectance in the red region (650 nm) and NIR (near-infrared radiation) is the surface reflectance in the near-infrared region (850 nm) (figure 4). The final average calculation of the average albedo and NDVI values for each of the 21 analysed cities has been done in ArcGis.

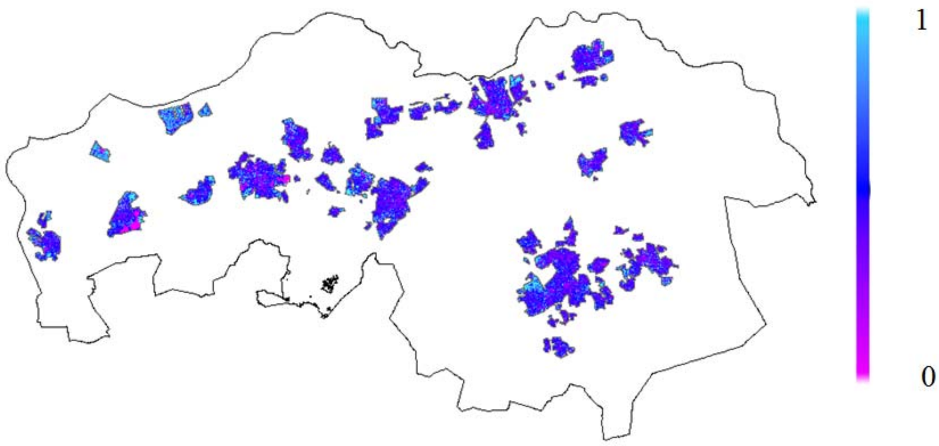


Fig. 3 Average albedo in urban areas of the province of North Brabant

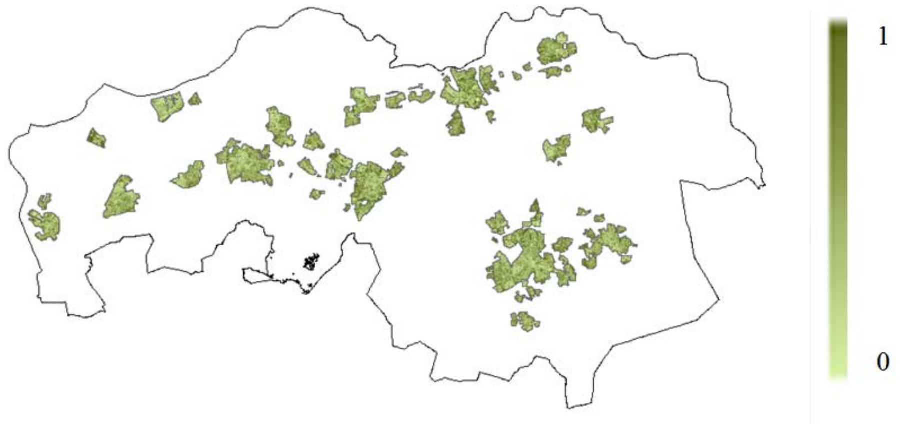


Fig. 4 Average NDVI in urban areas of the province of North Brabant.

The mapping and calculation of the average imperviousness was done calculating for each of the 21 midsize cities, the surface occupied by buildings and roads. We have processed in ArcGis the TOP10NL file to obtain the percentage of imperviousness for each city.

PARAMETERS RELATED TO CITY SIZE

The accumulation of urban heat is correlated with the size of cities. Several studies have made an effort to quantify the relationship between city size and the UHI effect. Oke (1973) found a linear relationship between the maximum urban heat island intensity (max UHI) and the logarithm of the population of cities in North America and in Europe: equations 1 and 2 that were obtained using data from the 1970s and 1980s.

North America

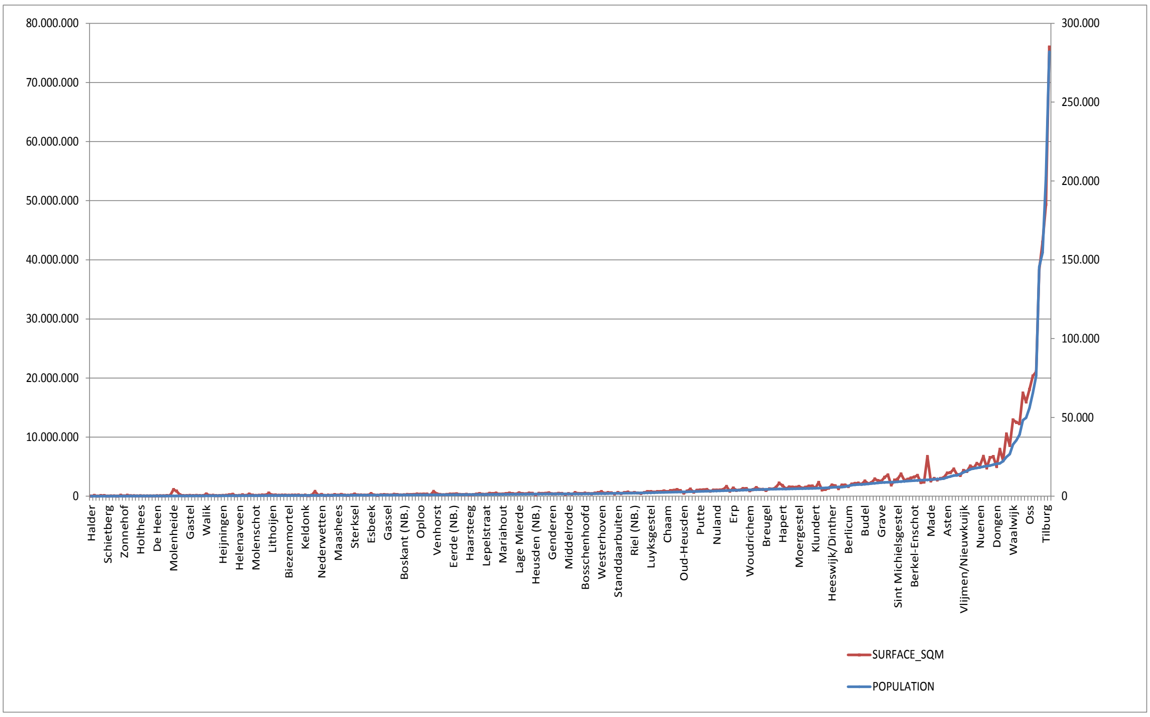
$$[\max UHI = 2.96 \log (P) - 6.41] \quad (1)$$

Europe

$$[\max UHI=2.01 \log (P) - 4.06] \quad (2)$$

Park and Kufuoka have attempted to find the relationships for South Korea and Japan (Park, 1986; Fujuoka, 1983). Hove(2011) highlights that the studies carried out with results from 1987 to 2008 reveal that there is a steeper relationship between the maximal UHI intensity and the population, and that the maximal UHI for Dutch cities with a population between 100,000 and 800,000 inhabitants would range from 4 to 8ºC. In

North-Brabant the vast majority of the midsize cities have less than 100,000 inhabitants (except for Tilburg, Breda,'s-Hertogenbosch and Eindhoven). This study aims at analysing how the size of smaller Dutch cities affects the UHI effect. For the analysis of the size of the cities we have chosen to analyse the city surface instead of the city population, since we have found a very high correlation (r2= 0.99) between the number of inhabitants (2006, PBL Netherlands Environmental Assessment Agency) and the surface of the cities (Graph 1).



Graph 1 Analysis of surface and population of North Brabant medium-size cities

2.2 THERMAL URBAN CLASSIFICATION OF MEDIUM-SIZE CITIES IN THE REGION OF NORTH BRABANT

In the second part of our study we have created a surface thermal classification map of the different neighbourhood typologies present in the analysed medium-size cities of the region of North Brabant. Urban climate classification maps provide practical information on the behaviour of different urban structures and climate, thus connecting climatological studies to urban planner´s reality. There is a first group of investigations that have been completed based on site measurements and available urban morphology documentation. It is the case of several studies carried out before. Chandler (1965) used climate, physiography and built form to classify Greater London in four zones. Auer (1978) analysed vegetation and building characteristics to create 12 "meteorologically significant" land uses in the city of St. Louis. Ellefsen (1990) analysed geometry, street configuration and construction material for the creation of "urban terrain zones". Wilmers (1991) worked on urban and rural structures, use and vegetation to identify the main "climatotopes" in Metropolitan Hannover. Scherer (1999) analysed land use and topography for the generation of a refined "climatope" classification of the region of Basel. Oke (2004) studied urban structure, cover, fabric, metabolism and potential to generate "urban climate zones". Stewart & Oke (2012), finally, researched "local climate zones" for urban heat island observation. There is a second group of papers that have produced urban climate classifications based on remote sensing analysis, which systematizes and makes it more cost effective. It is the case of the semi-automatic classification carried out for the city of Toulouse (Houet & Pigeon, 2011) to classify sample areas in "urban climate zones", the surface material assessment of urban zones for the generation of "urban structure types" in the city of Munich (Heiden et al., 2012), the socio-economic and environmental impacts of the different urban structures in the same city (Pauleit & Duhme,2000), the object-based image classifiation used to map urban structure typologies also in Munich (Wurm et al. 2010) and the land-use classification produced for metropolitan Atlanta (Tang, 2007).

In the Netherlands there are two main "urban living environment" classification systems. One is the one developed by ABF (ABF research, 2005) and the other one is RIGO-typology for neighbourhoods built before and after the war (RIGO 1995; RIGO 1997). Both analyse physical characteristics of housing and urban equipment but Rigo classification also takes into consideration socio-economic factors (Planbureau voor de leefomgeving, 2006). Even though these "urban living environment" typologies are consistent throughout the country, since 2004 the role of these classification systems has considerably been reduced since the approval of the Spatial Strategy of 2004 - Nota Ruimte 2004 (VROM, 2004) - which conferred most of the spatial policy competences to provinces and municipalities. Most provinces and municipalities have used these as a basis to develop their own classification systems to analyse the existing built environment and to create design guidelines for future developments from different angles. In the case of the province of North Brabant, an "urban living environment" classification was carried out based on physical characteristics of the neighbourhoods (location, density, housing typology and mix of uses) (figure 5) in the context of a housing survey carried out in 1998 (WBO, 1998) and further been used in other housing surveys of the region (Poulus & Heida, 2002). This classification establishes twelve main categories: high-density city centre, city centre, pre-war neighbourhood, post-war compact neighbourhood, post-war soil bound neighbourhood, urban green, small urban centre, small urban, small urban green, village centre, village, rural accessible.

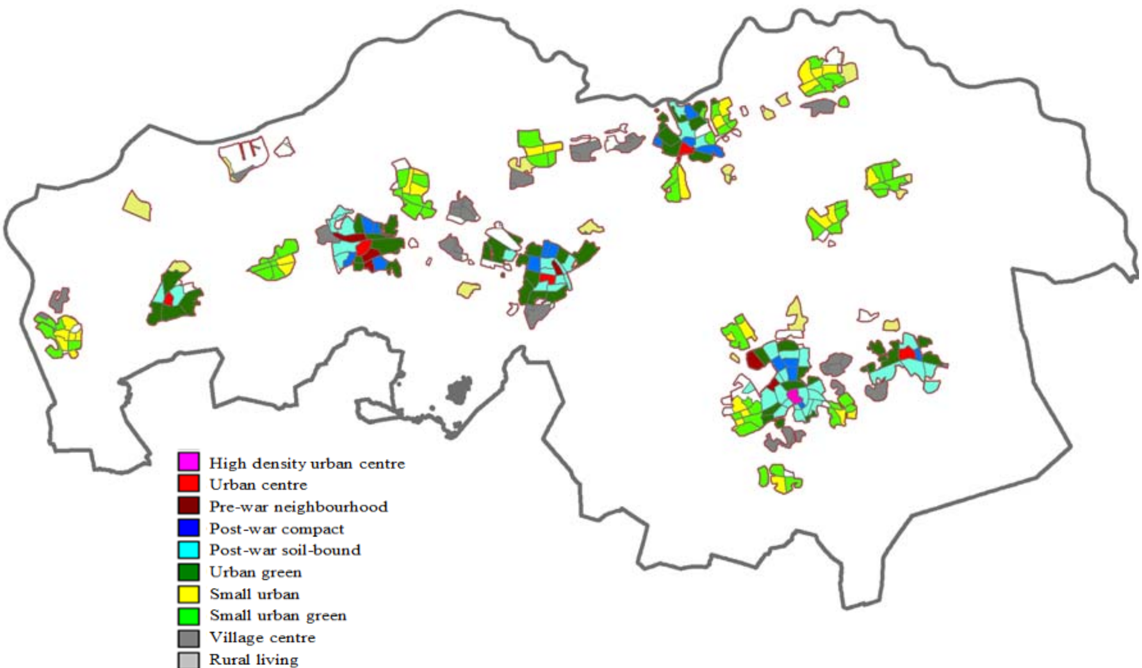


Fig. 5 Analysis of surface and population of North Brabant medium-size cities

In this study we have created a 6-cluster surface cover thermal classification of the urban cores of the region of North Brabant using the three most relevant parameters (identified in the first part of the study) influencing night time urban LST to complete an unsupervised cluster classification in GIS. Further we have overlapped the obtained surface cluster classification with the "urban living environment" classification of the region of North Brabant, in order to review this official "urban living environment" classification with surface cover thermal criteria.

3. RESULTS AND DISCUSSION

3.1 THE ROLE OF DIFFERENT PARAMETERS IN THE FORMATION OF THE UHI IN THE REGION OF NORTH BRABANT

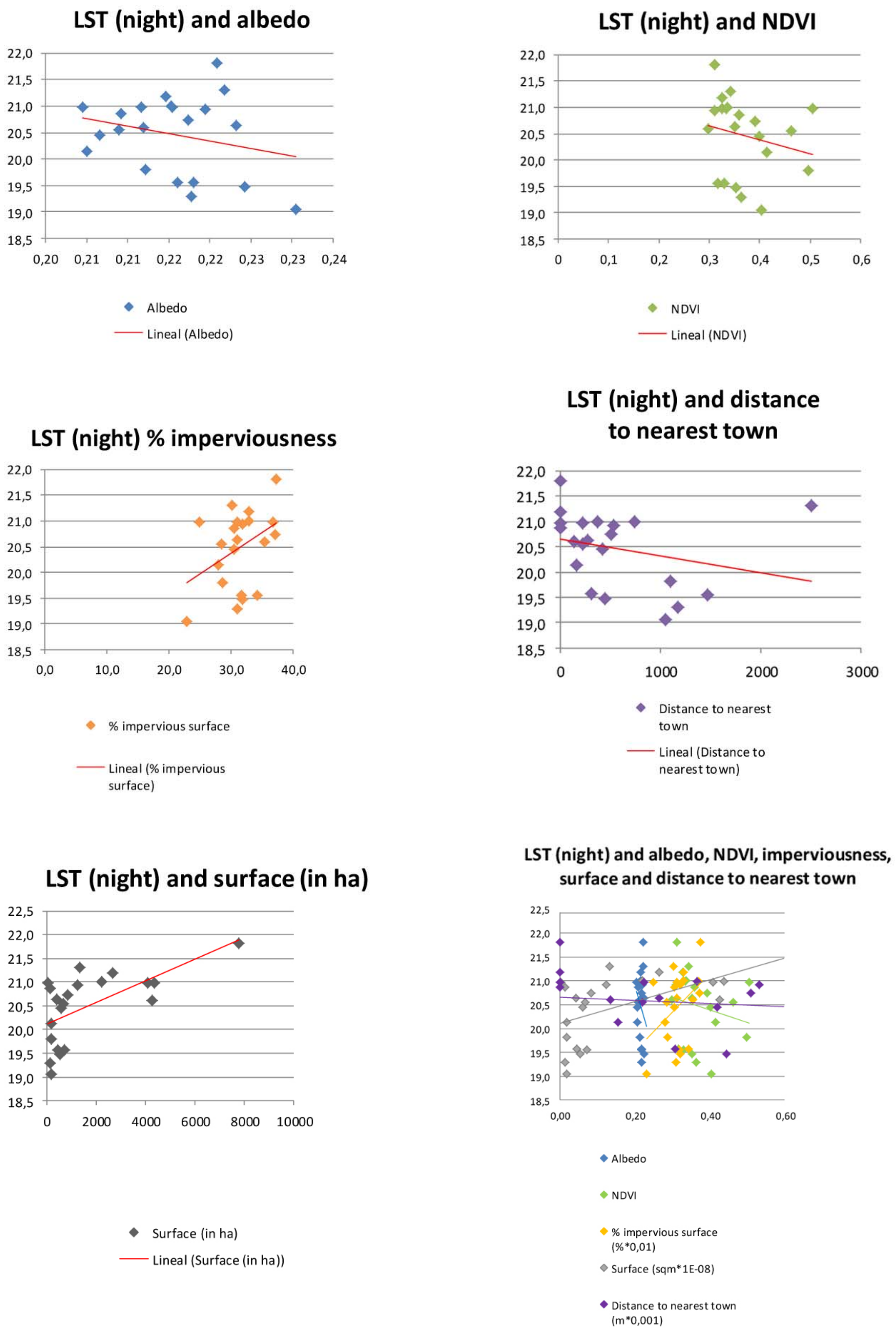
The multiple regression analysis of the average values obtained for Albedo, NDVI, imperviousness, distance to the nearest urban area and town size, shows that there is a multiple correlation coefficient of R=0.7 and R2=0.5 that relates these parameters with the average night time surface temperature (chart 1). We have obtained the following parameter coefficients:

LST (average night) = 27.7 – 34,8*A + 2.3E-08*S - 0,1*NDVI
Where A = Albedo, S = surface and NDVI = Normalized Difference Vegetation Index

It seems that the most relevant indicators in this case are albedo and NDVI (Graph 2). Imperviousness, the distance to nearest town and the surface of the analysed cities do not seem to play a significant role in the LST night values for the medium-size cities analysed in the region of North Brabant, which do not exceed 7,700 ha in any case. The maximum calculated average city night time LST difference is 2.9ºC. The average city albedo values are pretty similar for all cities and range from 0.20 to 0.23. NDVI variations vary from 0.31 till 0.50 and imperviousness coefficient ranges from 23% to 37.4%. The future growth of most medium-size cities of the regions will not per se aggravate the UHI phenomenon, in turn it will be the design of the new neighbourhoods, which will impact or not the formation of urban heat in the province.

Average Modis night time lst. July 2006.	Albedo	NDVI	% impervious surface	distance to nearest town (in m)	Surface (in sqm)
19,1	0,23	0,40	23,0	1051	1.731.927
19,3	0,22	0,36	31,0	1175	1.185.046
19,5	0,22	0,35	32,0	445	5.344.222
19,6	0,22	0,33	31,7	1472	7.077.232
19,6	0,22	0,32	34,2	306	4.523.848
19,8	0,21	0,50	28,8	1101	1.699.638
20,1	0,21	0,41	28,0	154	1.815.197
20,4	0,21	0,40	30,5	419	5.880.326
20,5	0,21	0,46	28,4	220	6.569.954
20,6	0,21	0,30	35,4	135	42.534.733
20,6	0,22	0,35	31,0	264	4.112.599
20,7	0,22	0,39	37,2	509	8.318.652
20,9	0,21	0,36	30,5	0	1.328.614
20,9	0,22	0,31	31,9	532	12.355.689
21,0	0,20	0,50	24,9	225	229.409
21,0	0,21	0,33	31,1	0	40.850.073
21,0	0,22	0,33	36,9	365	43.619.598
21,0	0,22	0,34	33,0	733	21.948.146
21,2	0,21	0,33	32,9	0	26.512.601
21,3	0,22	0,34	30,2	2500	13.259.052

Tab.1 Data list of the analysed medium size cities of the region of North Brabant. Parameters analysed: night time LST, albedo, NDVI, imperviousness, distance to nearest town and surface.



Graph 2 Analysis of the relationship between the different parameters and night time average LST, for each of the analysed medium size cities in the region of North Brabant

3.2 REDEFINING THE "URBAN LIVING ENVIRONMENT" CLASSIFICATION BASED ON THERMAL SURFACE COVER CRITERIA

3.2.1 UNSUPERVISED SURFACE THERMAL CLUSTERING

Even though the average LST presents maximum variations of 3ºC (section 3.1), we have completed an unsupervised cluster classification of the three most relevant surface cover parameters (albedo, NDVI and imperviousness), in order to understand the different surface behaviours within each town. We have obtained 6 different clusters.

Even though the average night time LST of these clusters are pretty similar, each of these clusters has a singular albedo, NDVI and imperviousness combination (graph 3).

The thermal surface cover assessment is more accurate when performed through the unsupervised classification of albedo, NDVI and imperviousness than through the calculation of the night time LST, due to the tools used in this study for these calculations.

Albedo and NDVI are calculated based on Landsat satellite imagery which has a resolution of 30 m and imperviousness is calculated based on a GIS model whereas night LST is calculated based on Modis 11A1 satellite imagery which has a 1km resolution.

Modis 11A1 has a resolution appropriate for average city LST calculations, but not for surface cover discrimination.

The combined analysis of these three parameters allows classifying different surface typologies. The scatterplots analysis (graph 4, 5 and 6) highlights the importance of the combined analysis.

There are many areas from different clusters sharing identical values for each parameter separately; however they present different albedo, NDVI and imperviousness combinations.

Even though the average city values for albedo, NDVI and imperviousness did not differ considerably from one city to the next (graph 2), the surface cover cluster analysis presents average albedo ranging from 0.11 till 0.30, NDVI varying from 0.18 till 0.55 and imperviousness coefficients going from 0.21% till 0.41%.

The spatial distribution of each of these clusters reveals that three of these clusters (clusters 1 to 3) correspond to clusters of built area surface cover, and three of these clusters (clusters 4 to 6) correspond to non-built areas surface cover clusters (figure 6).

Cluster 1 corresponds to specific urban areas with the poorest surface thermal behaviour, mainly present in small specific areas of the city centres or of industrial areas.

They have very low albedo (0,11), high imperviousness (39%), and low NDVI (0,17)).

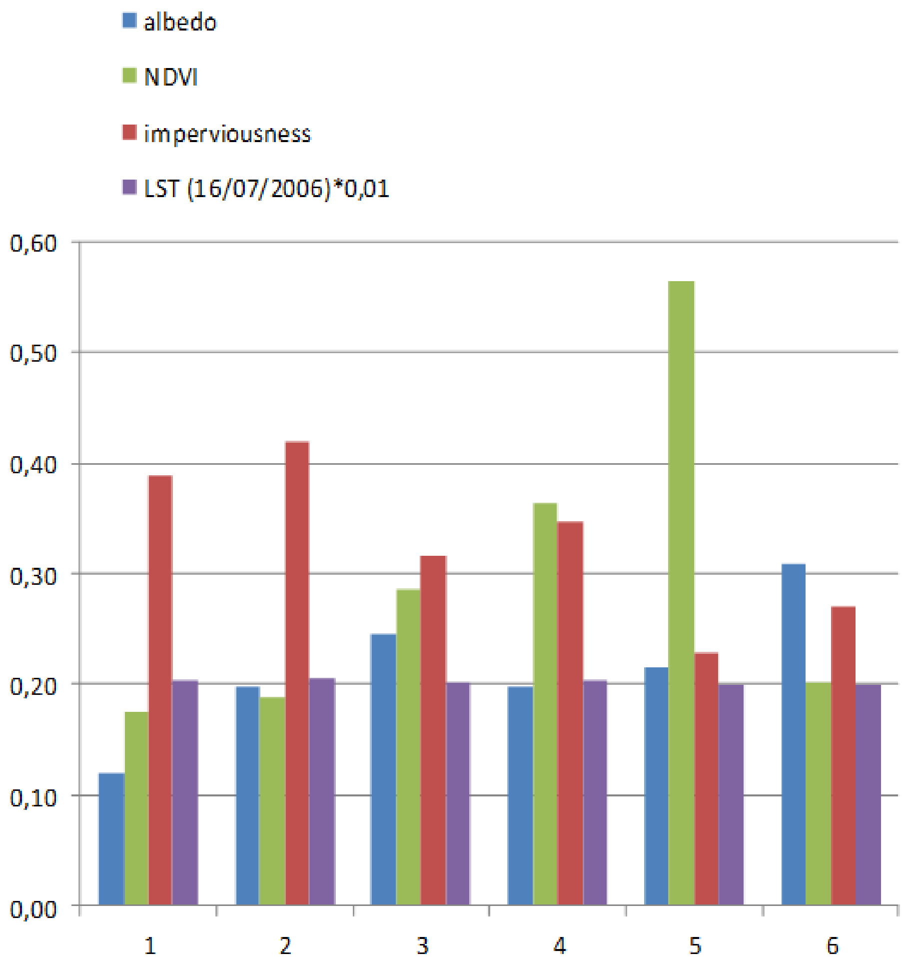
Cluster 2 presents a similar average NDVI value (0,19), slightly higher imperviousness (0,42) and considerably higher albedo (0,2) than cluster 1. The main difference between cluster 1 and cluster 2 is the albedo.

The majority of the city centre surfaces belong to cluster 2.

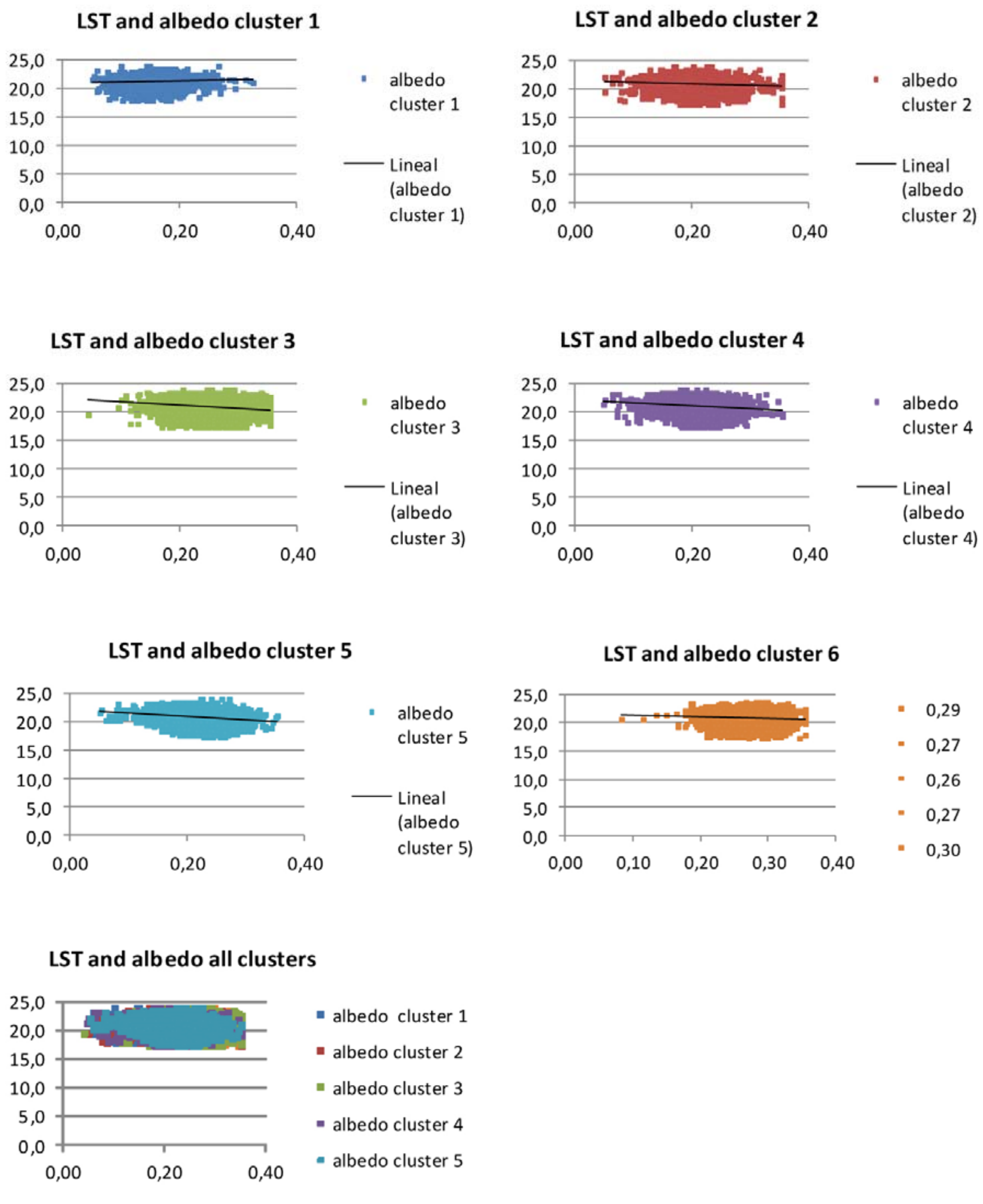
Cluster 3 seems to correspond to urban residential areas (row houses) with interspersed green areas, presenting a slightly higher albedo (0,24), higher NDVI (0,28) and lower imperviousness (0,31).

Cluster 4 can be identified with low density residential areas (detached houses) areas of urban parks with trees with higher NDVI, lower albedo (due to the presence of greenery) and slightly higher imperviousness.

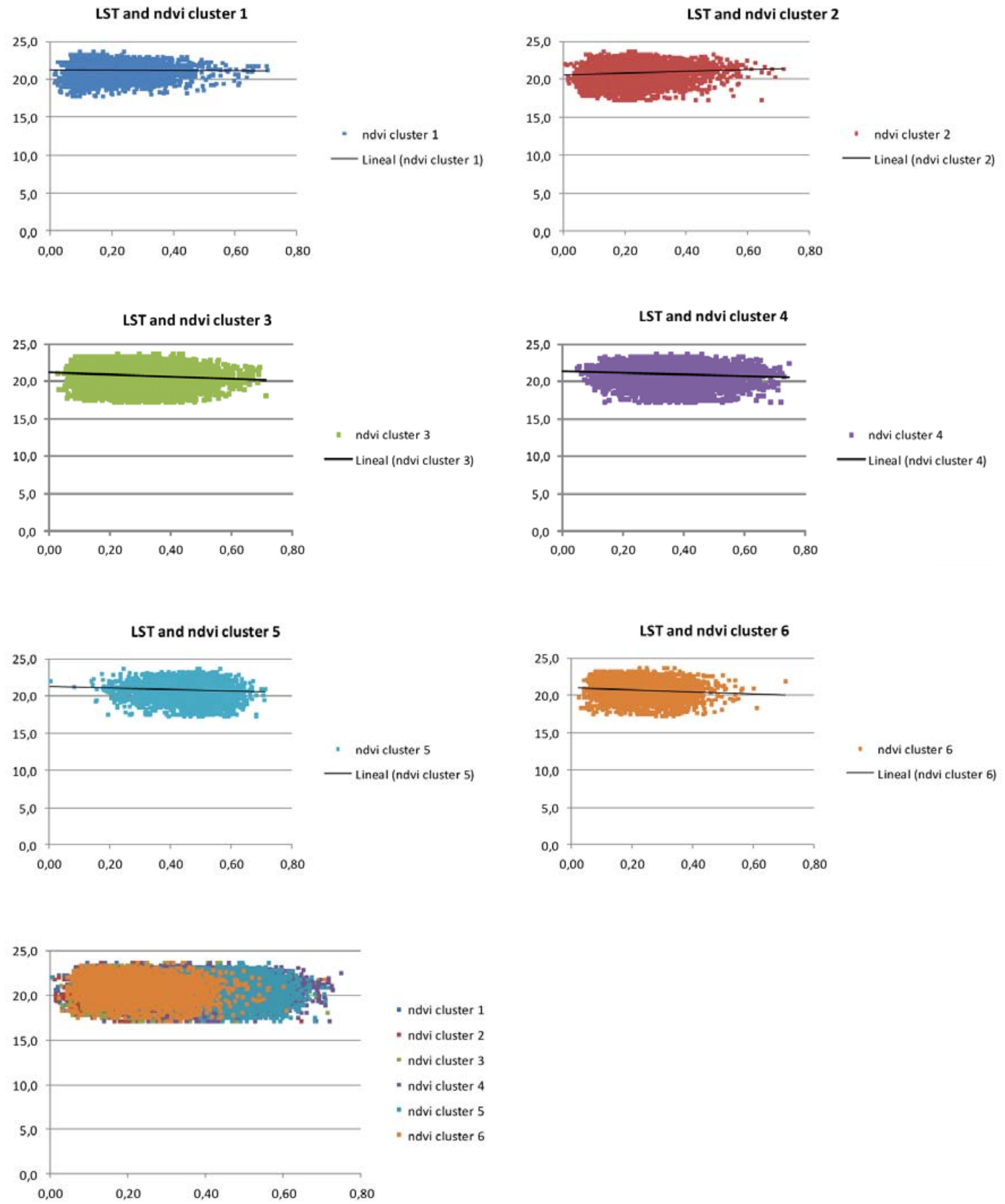
Cluster 5 corresponds to urban trees and water areas with the highest NDVI (0,55), the lowest imperviousness 22% and a relatively low albedo (0,21 due to the presence of vegetation) and cluster 6 corresponds to bare soil areas with the highest albedo (0,31), considerably low NDVI (0,20) and small imperviousness 26% (Graph 3).



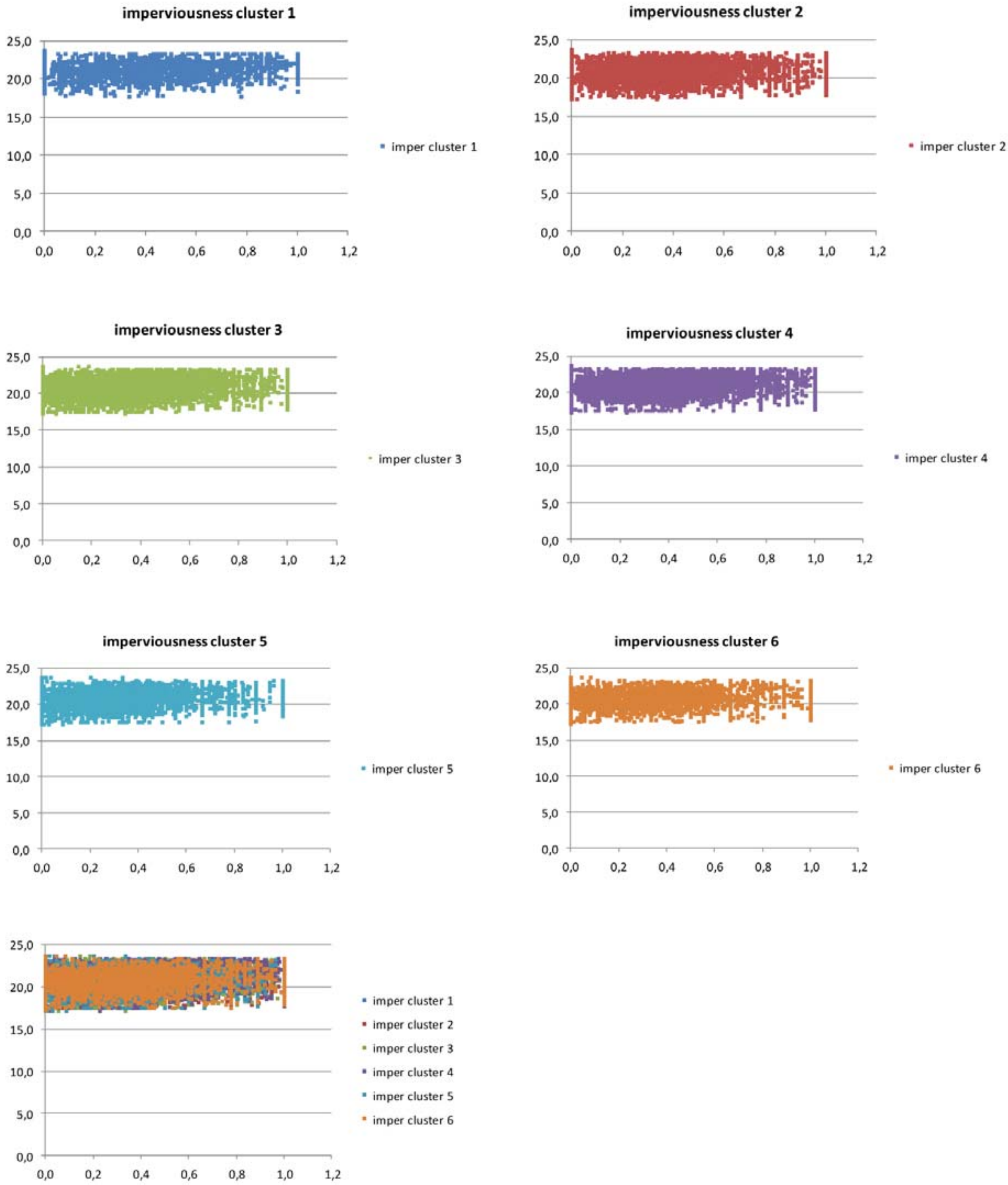
Graph 3 Average albedo, NDVI, imperviousness and night LST values for each of the 6 clusters resulting from the unsupervised classification of the albedo, NDVI and imperviousness maps of the analysed medium-size cities of North Brabant.



Graph 4 Scatterplots of night LST and albedo, for each of the different surface cover clusters



Graph 5 Scatterplots of night LST and NDVI, for each of the different surface cover clusters



Graph 6 Scatterplots of night LST and imperviousness, for each of the different surface cover clusters

If we analyse the case Eindhoven metropolitan area we can see that the city centre is mostly covered with cluster 2 surfaces, and that in turn, cluster 4 has more presence in areas outside the city centre. Cluster 1 is only present in very specific, heat absorbing surface areas, whereas cluster 6 is hardly present in the city area (this is why it was not included in the analysed figure) (figure 6 and 7).

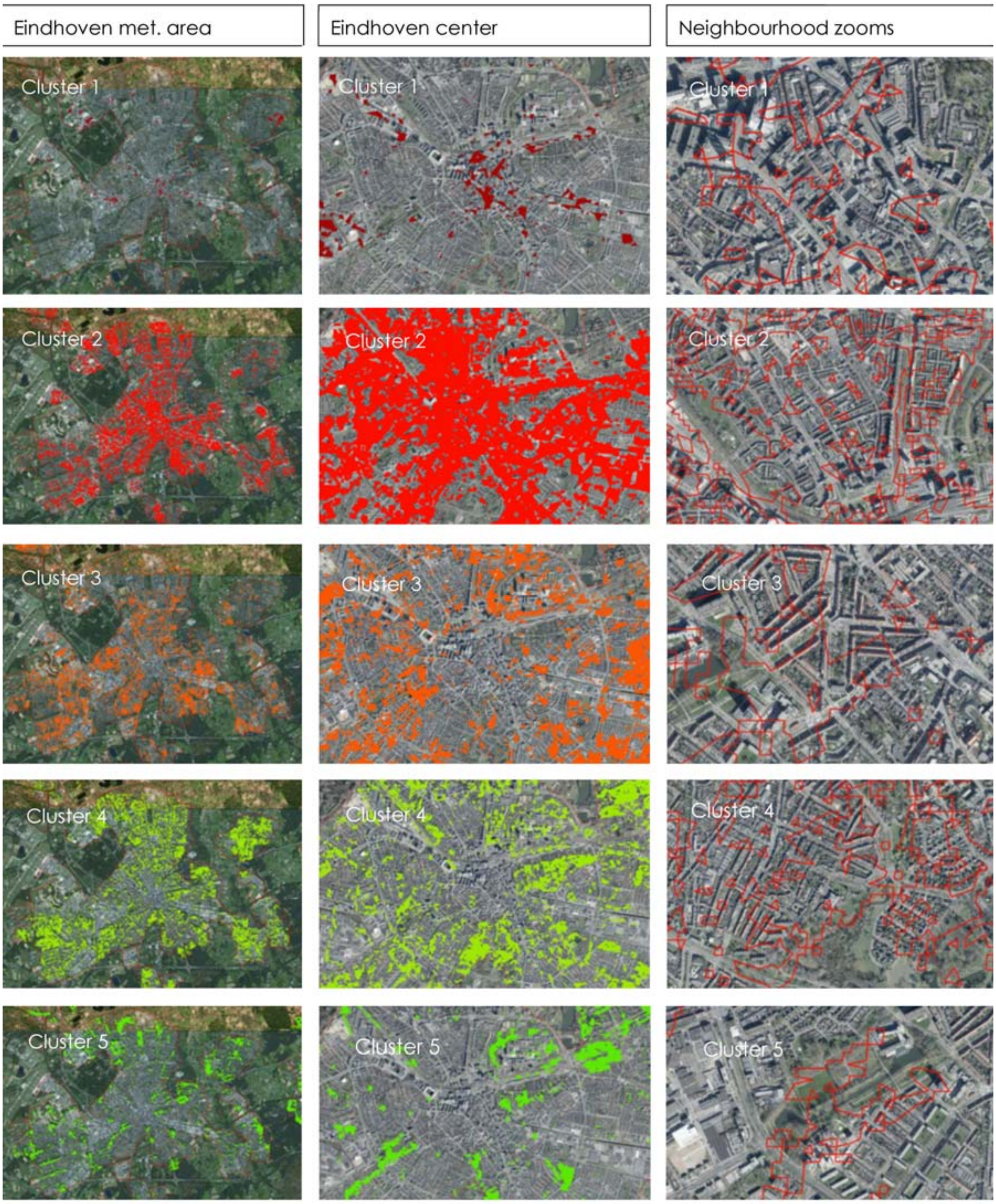


Fig. 6 Spatial distribution of surface cover clusters in Eindhoven metropolitan area

3.2.2 ANALYSIS OF THE PRESENCE OF SURFACE THERMAL CLUSTERS IN "URBAN LIVING ENVIRONMENT" CATEGORIES

The maps of Eindhoven metropolitan area illustrate the different spatial distribution of the clusters and the "urban living environment" maps. Each "urban living environment" map comprises a specific surface cluster mix (figure 7). In order to analyse how the surface thermal clusters match with the "urban living environment" categories of the region of North Brabant, we have calculated the proportion of clusters found in each of the " urban living environment" categories (graph 7). This analysis reveals that "urban living environment" classes 3, and 5 (pre-war neighbourhood and post-war ground based) present similar surface covers where clusters 2 cover more than 35% of the surface and where the proportion of urban clusters (1, 2 and 3) is in all cases above 60%.

The cluster mix analysis, also reveals that "urban living environments" 4, 6, 7, 8 and 9 (post-war compact, green, small urban centre, small urban and small urban green) present similar surface cover mixes, with similar cluster 2 and 4 presence, and where the proportion of urban surface cover clusters (1,2 and 3) is around 50%. We can establish that the 12 category "urban living environment" classification applied in North Brabant, could be reduced to a 7 surface cover classification.

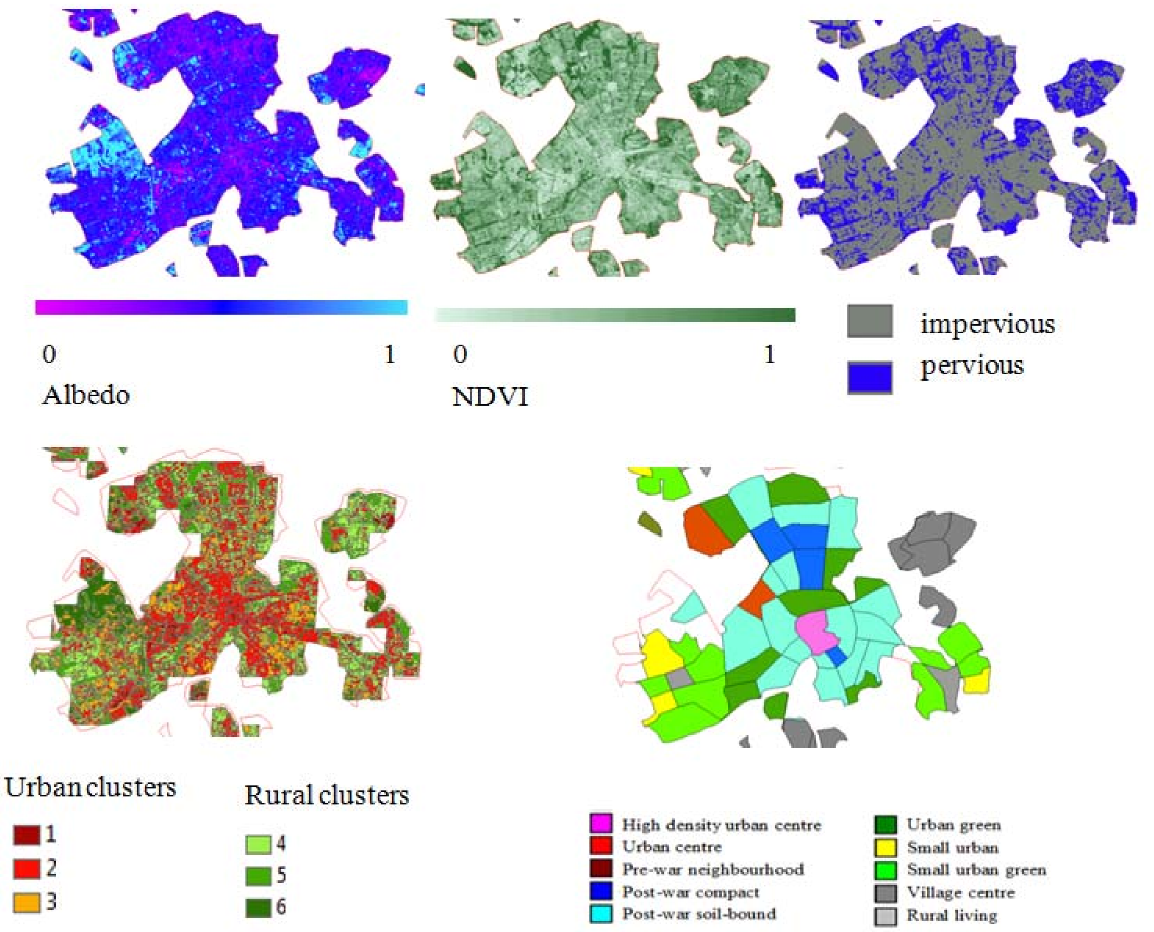
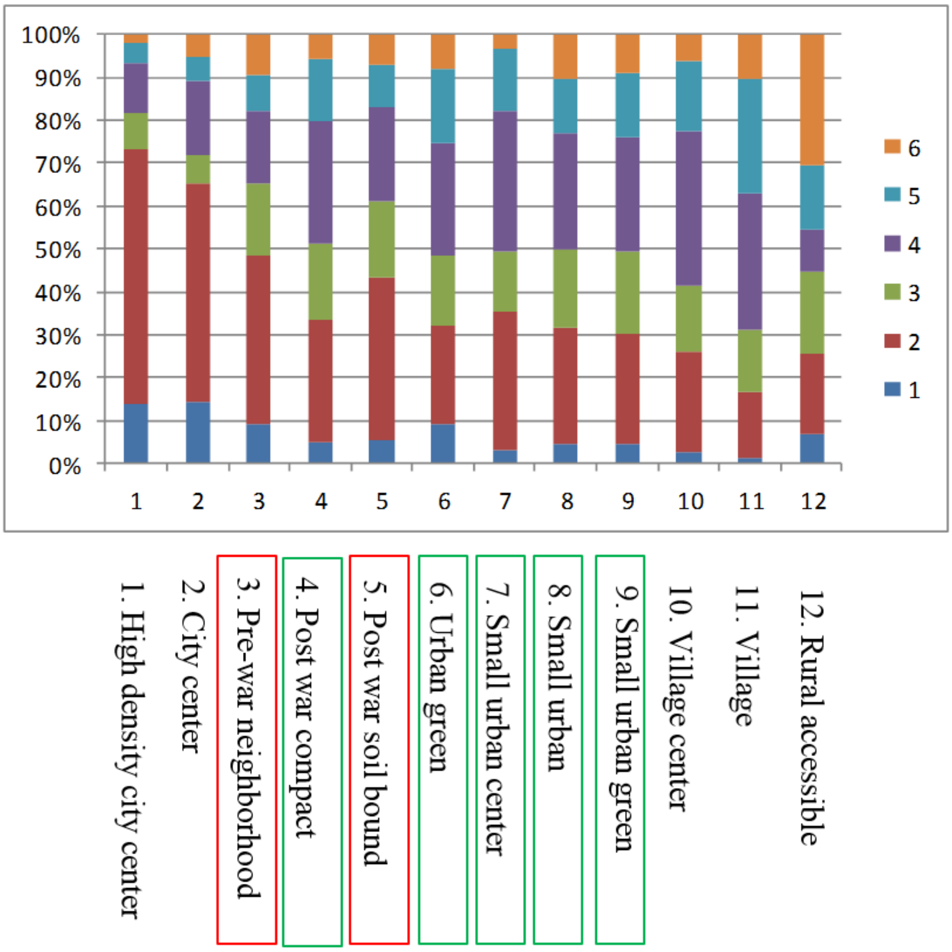


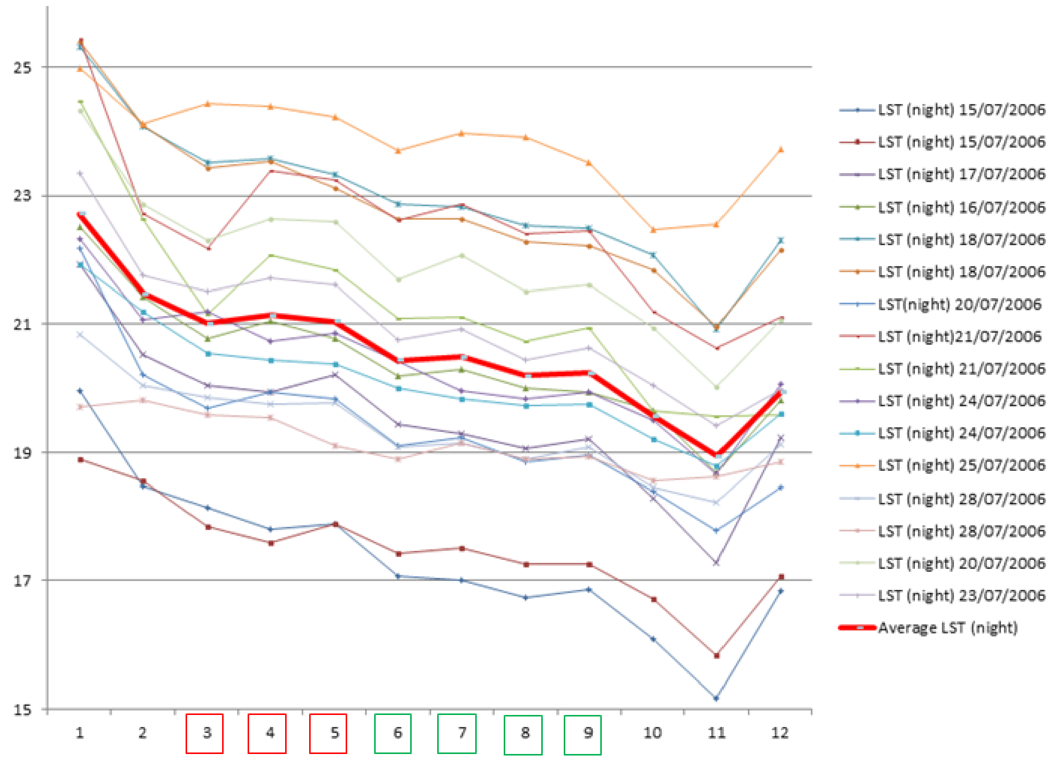
Fig. 7 Compilation of LST-related maps for Eindhoven metropolitan area: Albedo, NDVI, imperviousness, surface cover clustering and "urban living environment" categories



Graph 7 Surface cover cluster proportions for each of the “urban living environment” categories in the analysed medium-size cities of the North Brabant region. Neighbourhoods 3 and 5 present similar cluster proportions, and thus could be grouped. Neighbourhoods 4, 6, 7, 8 and 9 present similar cluster proportions, and thus could be grouped.

3.2.3 ANALYSIS OF AVERAGE NIGHT LST OF THE DIFFERENT “URBAN LIVING ENVIRONMENT” CATEGORIES

The analysis of the average night time LST retrieved by Modis 11A1 in 16 satellite images during the heat wave experienced in the month of July 2006 (Graph 8) reveals that 12 “urban living environment” categories could actually be grouped in 7, since categories 3, 4 and 5 (pre-war neighbourhood, post-war compact and post-war ground based) could be grouped into one single category since they present similar average LST (around 21ºC) and categories 6,7, 8 and 9 could be grouped into another category because they present similar average LST (around 20.3ºC).



Graph 8. Average night LST for each of the "urban living categories". Neighbourhoods 3, 4 and 5 present similar night LST, and thus could be grouped. Neighbourhoods 6, 7, 8 and 9 present similar night LST , and thus could be grouped.

3.2.4 PROPOSED "URBAN LIVING THERMAL CATEGORIES" FOR THE REGION OF NORTH BRABANT

The surface cluster analysis of the different "urban living environment categories" suggests that these can be grouped into 7 categories. 1/ High density city centre 2/ City centre 3/ pre-war neighbourhood & post-war soil bound 4/ post-war compact & urban green & small urban centre & small urban & small urban green 5/Village centre 6/Village 7/Rural accessible. The average night time land surface temperature analysis of the "urban living environment categories" suggests the same groups except for the post-war compact neighbourhood's category which has a night LST similar to pre-war and post war soil bound. The main reason is that post-war compact neighbourhoods is a category that consists of scattered high rise dwelling blocks, interleaved with green areas and large infrastructural roads. The proportion of green areas that can be found in these neighbourhoods is similar that the ones of small urban areas, however the overall night LST is higher in these post-war areas.

4 CONCLUSIONS

This paper addressed the main question how to ensure that the future development plans do not aggravate the urban heat island (UHI) effect in the North-Brabant urban areas, by focusing on three sub-questions: How bad is the urban heat island problem currently? How does albedo, normalized difference vegetation index (NDVI), imperviousness, city size and proximity to other urban areas influence the phenomenon? Which of these play the most relevant UHI role? Can we establish a surface thermal urban classification to provide design guidelines to ensure that future developments do not aggravate the UHI phenomenon?

The answer to the main question is found in adjusting the design of the growth areas that are designated by the province North-Brabant. The growth areas are based on the “ladder for sustainable urbanisation” developed by the Dutch Ministry of Infrastructure and Environment. The aspect of urban heat islands is not included in this methodology. We propose to include considerations about albedo, greenness (NDVI) and imperviousness, in the design of these future developments. Our study has revealed that albedo and NDVI are the most relevant parameters influencing the average night time LST for the analysed North Brabant medium-size cities. Correlation coefficients extracted from the multiple regression analysis are:

LST (average night) = 27.7 – 34,8*A + 2.3E-08*S - 0,1*NDVI
Where A = Albedo, S = surface and NDVI = Normalized Difference Vegetation Index

The surface cover cluster analysis of these three parameters reveals that the 12 “urban living environment” categories used in the region of North Brabant (high-density city centre, city centre, pre-war neighbourhood, post-war compact neighbourhood, post-war soil-bound neighbourhood, urban green, small urban centre, small urban, small urban green, village centre, village, rural accessible) can actually be reduced to 7 categories, since classes 3, 4 and 5 (pre-war neighbourhood, post-war compact and post-war ground based) present similar surface covers (and could thus be grouped) and the “urban living environments” 6, 7, 8 and 9 (green, small urban centre, small urban and small urban green) also present similar surface cover mixes (and could thus be grouped). This surface cover classification provides guidelines to improve the surface behaviour of the most common urban typologies that can be found in the province of North Brabant and to guide the urban design of the planned future urban developments. All of these conclusions could be integrated in a climate-robust growth areas policy.

5 DISCUSSION

The purpose of using the surface cover cluster analysis for the thermal assessment of the different “urban living environment” assessment (instead of calculating directly the average night time LST of each of these neighbourhood typologies) is to actually map and quantify parameters that can be addressed and improved. Measures to improve albedo, NDVI and imperviousness can be simulated and quantified. Mapping surface cover categories allows designing specific mitigation solutions, instead of only assessing on the intensity of the problem (night LST temperature).

The intention of the study is to analyse the thermal surface cover behaviour of the different “urban living environment” categories in order to design UHI adaptation measures in the existing neighbourhoods and to produce some surface adaptation guidelines for the future developments that will grow adjacent to the existing medium-size cities. The same urban structures can considerably improve their thermal behaviour though the implementation of measures that only affect their surface covers. We understand that parameters related to the neighbourhood structure (sky view factor, wind, shadow, ...) as well as factors such as anthropogenic heat emissions should be the object of another study to determine to what extent they influence the formation of the UHI in the province of North Brabant, and to explore and design the development of design guidelines concerning the urban structure for the design of future urban developments.

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IMAGE SOURCES

Cover image: Courtesy of the U.S.Geological Survey.USGS/NASA Landsat.Further processed

Fig. 1: Province North Brabant. Spatial vision, 2010

Fig. 2: Courtesy of the U.S. Geological Survey. USGS/NASA Modis

Fig. 3: Landsat image (Courtesy of the U.S. Geological Survey. USGS/NASA Landsat) further processed with ENVI 4.7 and Atcor 2.3.

Fig. 4: Landsat image (Courtesy of the U.S. Geological Survey. USGS/NASA Landsat) further processed with ENVI 4.7 and Atcor 2.3.

Fig. 5: ABF research, 2005

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The *Ninth International Conference on Innovation in Urban and Regional Planning* aims at raising a comprehensive spectrum of new and interdependent problems showing a multidisciplinary character and extends the horizon over which the city growth strategies and regional development strategies are defined.

This view calls into question not only technical or systemic issues, but heavily challenges societal and ethical aspects and assigns the needed research and innovation efforts, a new kind of responsibility.

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- **29th April 2016** - Deadline for Extended Abstract submission
- **27th May 2016** - Extended Abstract acceptance
- **1st July 2016** - Deadline for Early Registration
- **29th July 2016** - Deadline for Late Registration

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ASPECTS OF LAND TAKE IN THE METROPOLITAN AREA OF NAPLES

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ABSTRACT

Land take is a phenomenon of great concern nowadays because of the large number of its negative impacts regarding biological, economic and social balance. In Italy, the development of urban and other artificial land has been irreversibly transforming a non-renewable resource such as soil, regardless the almost constant population rate, with different speed depending of the region considered. The aim of this paper is to analyze the phenomenon in the metropolitan area of Naples, which is an area highly affected by territorial aggression of human matrix. The data used are both by the Institute for Environmental Protection and Research (ISPRA) Report 2015 on the usage of the land and by ISTAT relating to the resident population up to the 1st of January 2015 and the extension of land for agricultural use (Census 2010). The mathematical combination of this data creates a new indicator that can be referred to as “residual land”; this residual area is of great extension with many different characteristics and it could represent the area where the phenomenon of land take most occurs. The identification, measurement and analysis of “residual land” provide new insights on the evolution of land take and this new indicator can represent a critical element to work on to prevent future land transformation and protect natural and agricultural areas within the Italian context.

KEYWORDS:
Land Take; Urban Sprawl; Soil Sealing; Metropolitan Area of Naples.

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那不勒斯城区的土地占用现状

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摘要

土地占用给生物、经济和社会平衡带来许多负面影响，备受社会关注。在意大利，尽管人口增长率在各地区会有差异，总体上几乎保持稳定增长，但城市和人造土地的发展已经不可逆转地使土壤等不可再生资源发生了改变。本文研究的目的是分析那不勒斯城区被人类高度占领的现象。本文使用的数据来自于环境保护和研究所（ISPRA）于 2015 年发布的土地使用报告，以及意大利国家统计局（ISTAT）对 2015 年 1 月 1 日以来居住人口和农业用地扩张的统计（2010 年的人口普查）。对这些数据进行数学相加可以产生一个表示“剩余土地”的符号。剩余土地的大力扩张有许多不同的特征，它能代表土地占用现象最常发生的地区。对“剩余土地”进行定义、测量和分析能扩大我们对土地改革的认识，同时，这也是预防土地在未来发生转型，并保护意大利自然和农业区域的关键因素。

关键词:
那不勒斯城区；土地占用.

1 INTRODUCTION

The importance of a good use of the territories has been underlined by the European Commission in 2011, year of the publication of the Communication entitled "A resource-efficient Europe - Flagship initiative under the Europe 2020 Strategy", in which land represents one of the factors to consider in achieving an always greater efficiency in the use of natural resources. It follows the former "Thematic Strategy for Soil Protection" (EC, 2006).

In this context, this paper introduces land take in the metropolitan area of Naples. The aim of this work is to delineate this phenomenon in an area highly affected by territorial aggression of human matrix. This delineation is possible thanks to the use of significant numerical indicators. More specifically, the data used was both information by the ISPRA (2015) on the usage of land in 2012 and data by ISTAT relating to the resident population up to the 1st of January 2015 and the extension of land for agricultural use (Istat, 2010).

The paper is structured in three parts. In the first part, the concept of land take is introduced with some of the negative definitions connected to the phenomenon, relating both to the processes of biological depletion and to that of a reduction of life quality due to the spread of low-density urbanization (Mazzeo, 2009; Russo, 2014). In the second part, the main indicators of national and regional land consumption are analyzed focusing on those relating to the metropolitan area of Naples. It is pointed out that the area of analysis does not coincide with that of the province of Naples that, pursuant to the law 56 of 2014, has become the Metropolitan city of Naples. The area analyzed, indeed, includes an area which extension leaves aside functional and relational considerations. This area is made up of municipalities that are part of the Caserta's and Salerno's district and ones that were once considered part of Naples' district. The boundaries of this area have been built by Mazzeo (2010) and have been used in Papa & Mazzeo (2014). The third part of the paper points out how the difference between land cover, built-up area and agricultural area interests an unutilized part of the land of great extension and having itself a number of different characteristics. Because of its heterogeneity, this land has to undergo an in-depth analysis so to prevent more useless loss of natural soil.

2 LAND TAKE. GENERALITIES AND DEFINITIONS

2.1 ENVIRONMENTAL ASPECTS

Land take is a human-derived process that leads to the use of both agricultural and natural land to produce volumes, tools, and infrastructural systems. This has, as a result, the continuous transformation of these areas into built-up areas. Land take is an irreversible process. «Land is a non-renewable resource, as the period needed to form new soil is extremely long, fundamental not only for the production of food but for all human activity, but also as the preservation of biodiversity, support for the closing of nutritive elements' cycle and for the balance of the biosphere» (ISPRA, 2015, 1).

The idea of land consumption is analyzed under a three dimensional space (length and width and the narrow layer of mineral particles, organic material, water, air and living organisms) that, when scarified, is not able to be used for it's soil functions: growth of vegetable species and the trading processes between organic and inorganic materials. The thickness of this layer usually goes between a couple centimeters to few meters. If compared to the rest of the earth it is clear how extremely fragile the basis for biological life on earth is.

It has been said that once eliminated this layer would take an incredibly long time to form again and it is not certain that the process of formation would take place because of the complex interactions between the soil and natural matrices. An example would be the process of desertification that interest areas of land once productive. Furthermore, the same can be observed in the process of a massive use of chemical products on agricultural lands which reduce the biological characteristics of the soil eventually leading it to infertility.

From what has been stated, we cannot talk of land consumption when the process of reconstruction of the soil layer results reversible in short times. Anyway, land take is closely related to human transformations of the territory and has nothing to do with the natural evolution of the land.

2.2 URBAN ASPECTS

From a general point of view, it is possible to imply that land is composed by three principal parts (Chart 1): urbanized land, agricultural land, and natural land. The latest trends point out that both urbanized and natural land tend to grow diminishing this way the agricultural area which is the most interesting for its productive impact and for its regulative functions.

Land take is defined by EEA (2015) as the «increase in the amount of agriculture, forest and other semi-natural and natural land taken by urban and other artificial land development. It includes areas sealed by construction and urban infrastructure as well as urban green areas and sport and leisure facilities. The main drivers of land take are grouped in processes resulting in the extension of:

- housing, services and recreation,
- industrial and commercial sites,
- transport networks & infrastructures,
- mines, quarries and waste dumpsites».

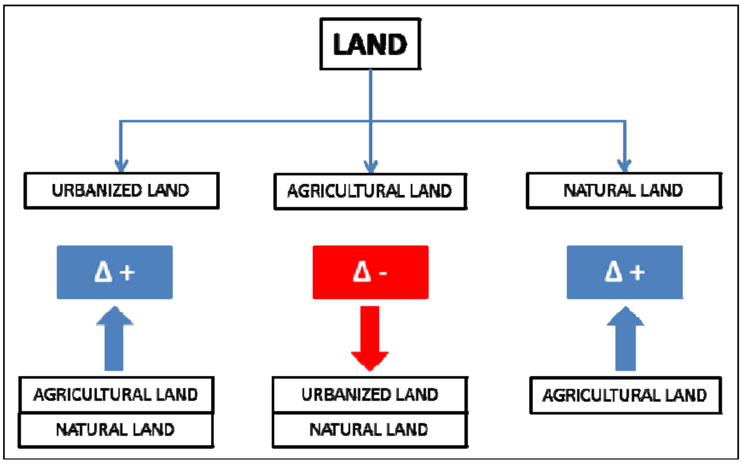

Chart 1 Land in its different forms and the trend variations

The debate relating to land take has become one of the main points in the analyses on urban evolution. Although a formal definition of land take exists, a shared methodology to measure the phenomenon is still missing, and this lack makes the implementation of strategies aiming at curbing land take more difficult and less effective (Zoppi & Lai, 2014).

Urban agglomerates tend to expand creating many issues on different fronts: from mobility to that of reduction of agricultural spaces, and from the modification of natural ecosystems to the change of the relations between people and social groups. Land take is one of the most outstanding aspects of urban expansion as the recent trend history of the cities always see this indicator in growth. If we start from housing manufacture, considered as the basic constructions of a city, we can imply that every new construction uses up land. This does not mean that the volumes of expansion are equal to a consumption of new land. More in depth three cases can be hypothesized:

- when new constructions are built on an area of land that has never been used before for urban aims. This is a typical example of volumetric increase (V2>V1) with a consequent increase of built-up area (S2>S1);

- when a new construction is built on a soil that had already been urbanized before. This is an example of volumetric increase (V2>V1) with no increase in built-up area (S2=S1);
- the third example relates to maintenance works, of renewal and renovation which can have as a result the same volume (V2=V1) or an increase of volume (V2>V1), that can end up in an increase of built-up area or the maintenance of the same built-up area (S2≥S1).

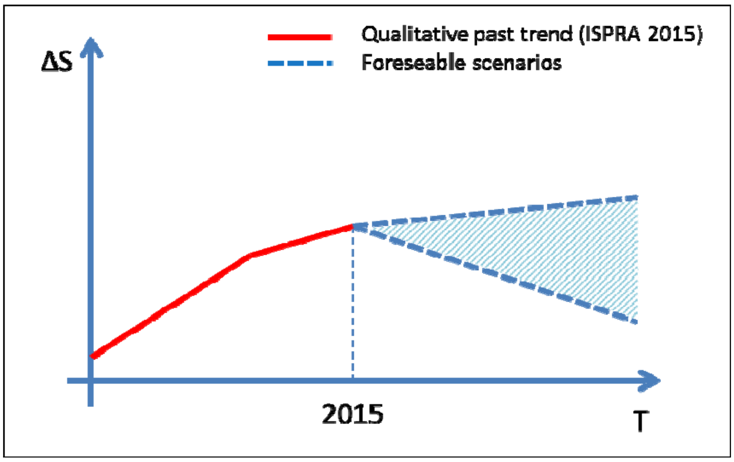

Chart 2 Intensity of land take in time in Italy

Extending this concept to the city, we can state that the evolution of the quantity of volumes on the corresponding coverage of land, resulting from the sum of all the transformations done, can reasonably be always considered positive even if it varies from time to time (Chart 2).
Another element that has to be considered in this analysis is population. In general, it is stated that the stabilization of the population (and in some cases its regression) does not have any effect on a parallel stabilization of the urban loads, even if the direct correlation is still used in urban studies (Zullo et al., 2015). This means that frequently an increase in the volume of built-up areas occurs in places where there is a decrease in the population (Chart 3).

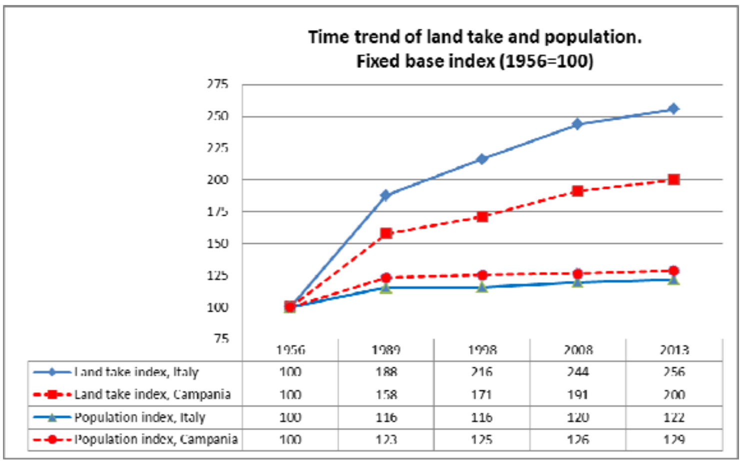

Chart 3 Trend in the growth of population and the use of land in time from 1956. Fixed base index 1956=100. Elaboration of the authors on data ISPRA (2015) and Istat

Population's trend and land take are two indicators considered directly dependent. This means that the growth of population produces an increase in soil consumption. Nevertheless, this direct relationship is not so immediate anymore, as it was in the past (Artmann, 2014).

In particular, for the whole period from the late Nineteenth century to the years of the economic development following the Second World War, we can assume a strong positive correlation, because population growth corresponded to a similar urban expansion process.

Today such relationship is weaker, given that the increase of new built-up areas occurs in the face of a stable population and with urban centres facing a phenomenon of physical and functional abandonment of inner areas to urban fringes. This means that the determinants of land take are more complex than a simple correlation with the population.

A first consideration is related to the needs and necessities of today's society. According to Munafò (2013, 20), «if in 1956 each Italian person was associated to a loss of 170 square meters of land, in 2010 this value doubled, rising to more than 340 square meters». This means that changes within the society have also influenced its demands and have created a greater need (effective or induced) for per-capita areas.

A second consideration is of economic nature. The transformation of land in built-up areas is a way to immobilize large financial resources because real estate is still considered a good field of investment. Meanwhile, the taxation of real estate has become one of the main financial resources for local authorities. These aspects are pushing towards the realization of new volumes and a reduced attention to territorial control (Ombuen, 2013).

Using soil means using a natural resource as a building site to enhance its value. An hypothesis that can be made is related to the dimension of the multiplier as there is a suspect that it diminishes, at least for two reasons: the first one is lack of demand (if the demand is the same but the volumes increase the cost to use them decreases), the second is for the potential risk increase that the transformed territory under goes.

A third consideration is related to the fact that still today there is a lack of attention to environmental goods, reflecting the perseverance of indifferent economic policies to the negative implications of an indiscriminate use of resources. In other words, the fact that environmental goods are not clearly associated with a tangible economic value makes them scarcely evaluable in economic analyses, despite it is well established that their loss is to be considered a net cost.

A fourth consideration concerns the farmlands. For a long time, they have been considered as reserve areas devoted for future urbanization and not as specialized functional areas dedicated to a primary economic activity to be protected and enhanced. It is interesting to note that there has been a difference in treatment between natural and agricultural areas: while the former were seen as areas to be protected for their ecological and landscape characteristics, the latter have not received the same attention.

This different treatment comes from the fact that, normally, the agricultural areas are closer to built-up areas than the natural ones and, therefore, are automatically more attractive and less easily protectable.

The extension of built-up areas develops on a physical substrate, which is the territory. The choice of the land to urbanize results from a number of factors (Graph 1).

Physical factors, such as the morphological conformation of land, administrative factors, which insert the piece of land into the usable land, economic factors such as the existence of people willing to work on the territory and of a sponsor fund, infrastructural factors such as the existence or the plan for communication networks and of specialized networks.

Many critical issues relating to the physical factors can be overcome with expensive advanced engineering techniques. Administrative factors define a variable use of the territory that extends from the complete prohibition to the total use conditioned by specific parameters. Price factors and the presence of sponsors become more evident in a phase after that of planning unless the planning does not already contain the sponsors' investment plans and includes them in a more general plan. In conclusion, the role played by the infrastructures is fundamental, especially for the introduction of new tools and facilities these networks create in the investment on the territory.

FACTORS	SPECIFICAL TERRITORIAL INDICATORS
1. Physical factors	1.1 soil morphology 1.2 geological soil structure 1.3 soil productivity
2. Administrative factors	2.1 juridical state of the new areas for urbanization 2.2 juridical state of the areas for transformation 2.3 juridical state of the bounded areas 2.4 necessity of stock by the public authority 2.5 time needed to start the activities
3. Stakeholders and financial resources	3.1 presence of both public and private employees 3.2 will of the employees to start the project 3.3 financial availability
4. Infrastructural factors	4.1 existing infrastructures 4.2 planned infrastructures 4.3 physical accessibility 4.4 accessibility to information

Graph 1 Factors that influence land choice

The combination of these four factors can be highly variable and can be related to other factors which have not been considered. This determines a transformation parameter that describes the easiness or not of the investment in a certain territorial area. In particular, it describes the advantage of using new land (new buildings or new infrastructures) compared to the utilization of already built-up areas. In the urbanized areas, in fact, there could be specific problems that make them less attractive such as the need of drainage. Therefore, the combination of these factors determines area's potential of transformation. The indicators can be manipulated so to be used also to predict trends speculating on the fact that some can be influenced by external factors not predictable in the beginning phase (Mazzeo, 2012); for example, some of these factors would be the trend in the cost of fuel and energy or factors related to the trend of local or national wealth. These and other trends can influence, even in a relevant way, the preference of a location's choice.

3 LAND TAKE IN ITALY

3.1 NATIONAL AND REGIONAL DATA

The problem of land take has been one of the principal issues for urban planners for a while and has created a complex interdisciplinary debate (Ewing, 1997; Antrop, 2004; Gibelli et al., 2006; Pileri, 2009; Berdini, 2009). The main concerns pointed out by researchers are based on the dimension of the phenomenon. This has moved the focus on the way tools to measure land consumption are built and to how to keep under control the dynamics of the evolution of the phenomenon (Munafò et al., 2013; Artmann, 2015). This concern has grown with the dispute that the urban expansion in Italy (not only) has followed completely autonomous rules. At first glance, it might be thought that population and expansion are tightly related. Actually, it has been so for a long time but it is not anymore. As a result, even though the population stays stable land occupation will continue growing regularly (Artmann, 2014). This can imply that the phenomenon is more related to economical process than to the population, meaning that there are investments made even if there is no need of new infrastructures or building and ignoring the fact that there are unused stocks in continuous growth.

A third aspect that has contributed to the focus on this phenomenon is the ecological importance of soil. Given that the new agricultural techniques make production more efficient and possible in different environments, the agricultural soil remains the main source of food production for humanity. The idea of reducing its extension is a growing insanity, especially in the geographical areas such as Italy where it's products quality is recognized worldwide.

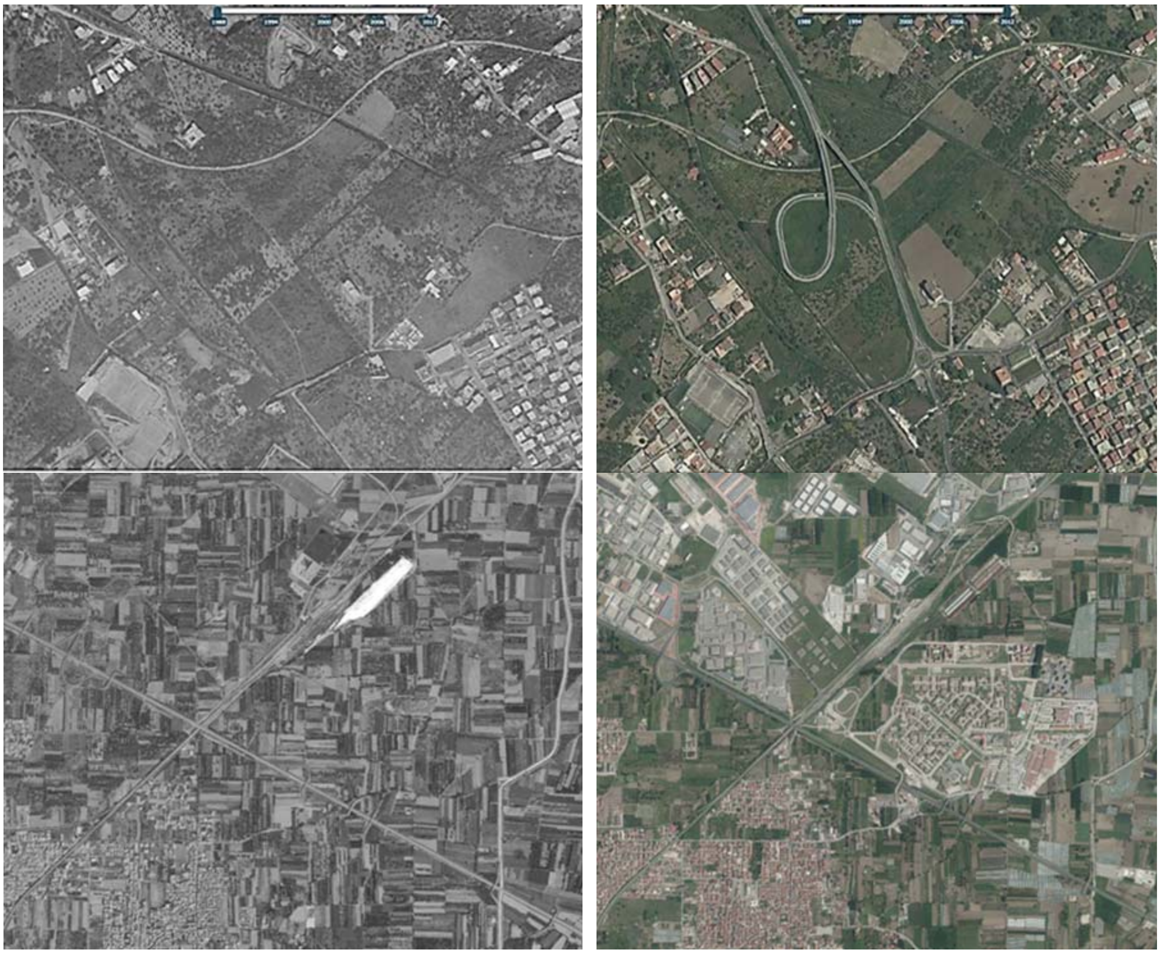

Chart 4 (a) Farming land between Cercola, Pollena Trocchia and Massa di Somma. (b) Farming area between Aversa, Caivano and Marcianise. Images 1988-2012. Source: Rete Natura 2000 (2015)

In 2014, ISPRA has presented its first Report on the consumption of land in Italy, updated with the 2015 edition. In this last edition, ISPRA has made accessible to the regions, municipalities and provinces a system of open access data, referred to 2012. The following analyzes have been created based on data from ISPRA 2015. Graph 2 defines the different kinds of areas in which the two categories of built-up and not built-up areas are collocated. These two categories are analyzed in general with different geographical scales by the Rapporto ISPRA without the report being in the dimensional specification of the subtypes. The study of ISPRA 2015 explains all the methodological indications given here from granted.

The first data shows the percentage of built-up land on the total. In order, Campania results as the third Italian region with an incidence of 8,33% preceded only by Lombardia and Veneto.

Some preliminary remarks. The kind of development of the two northern regions is due to the economic growth of the last decades. The urban expansion is closely related to the economic expansion and to the production of incomes. In Campania, this process barely exists. It can be so said that the urban development partially results from economics having as main drive other kinds of powers and practices not legal. The element that increases the phenomenon's seriousness is that this process has involved the most productive areas once known as the Campania Felix.

BUILT-UP LAND	NOT BUILT-UP LAND
* Buildings, Sheds	* Trees or shrubs in urban areas
* Asphalted roads	* Trees or shrubs in farming land
* Dirt roads	* Trees or shrubs in natural areas
* Squares, parking places, yards and other paved or dirt areas	* Areas for planting
	* Meadows, grass vegetation
* Train stations and railway site	* Water plants
* Airports and ports (only decks, runways and waterproof areas)	* Riverbeds
	* Wetlands
* Waterproof sport tracks	* Rocks, soil, sand, dunes
* Permanent greenhouses	* Glaciers and areas with permanent snow
* Photovoltaic ground fields	* Non waterproof sports areas
* Not renaturalised extractive areas, dumps	* Non waterproof urban areas
* Other waterproof areas	* Non waterproof farming areas
	* Non waterproof natural areas

Graph 2 Classification used to evaluate the use of land (ISPRA, 2015)

The data shown in Graph 3 helps to create an indication on the ratio between resident population up to the 1st of January 2015 and the built-up area, which is the number of residents on every square kilometer of built-up land (Chart 5 and Graph 3). We can observe that the values are very variable among each other, going from a minimum of 2.346 of Friuli-Venezia Giulia to a maximum value of 5.353 of Lazio, while the average is around 3.000.

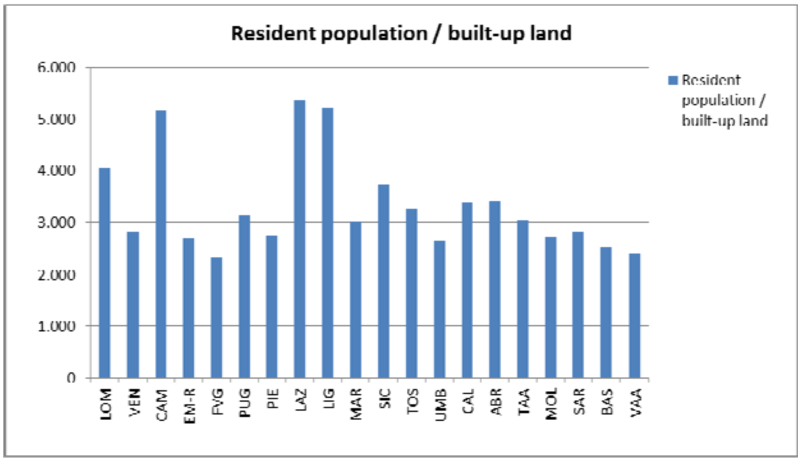

Chart 5 Resident population for every unit of built-up land calculated by the authors

We could say that this ratio is an indicator of the efficiency of the territorial management system, in the sense that when it grows the density in the used land grows too. The ratio can also be considered as a value of incidence of the spread of the population on the built-up area and as a possible indicator of the urban sprawl.

If we consider an analysis of the consumption of land between 1956 and 2015 and we reclassify the regions in terms of the percentage increase of land use, the ranking changes completely (Graph 4 and Chart 6). In the period 1956-2015 the region which has had the greatest "acceleration" in the consumption of land is Lazio, that passed from 1,86 to 6,39, with an increase of 243%. Second place is Emilia Romagna with an increase of over 200%. Campania is at the 14th place, with an increase of 85%, another interesting fact is that urbanization has been present in the region from ancient times making Naples, a century ago, one of the most populated cities in the world. In 1956 only the region Lombardia had more built-up areas than Campania (4,49 for Campania against 4,86 for Lombardia).

REGION	BUILT-UP LAND [KM2]	NOT BUILT-UP LAND [KM2]	NOT CLASSIFIED AREAS [KM2]	BUILT-UP LAND [%]	RESIDENT POPULATION (2015 ISTAT)	RES. POP. / BUILT-UP LAND (AUT)
Lombardia	2.464,17	21.254,68	144,26	10,39	10.002.615	4.059,23
Veneto	1.744,11	16.582,36	80,39	9,52	4.927.596	2.825,27
Campania	1.135,95	12.508,60	26,05	8,33	5.861.529	5.160,04
Emilia-Romagna	1.642,17	20.777,26	32,78	7,32	4.450.508	2.710,13
Friuli Venezia Giulia	523,10	7.306,82	32,24	6,68	1.227.122	2.345,88
Puglia	1.302,52	18.238,00	0,00	6,67	4.090.105	3.140,15
Piemonte	1.608,49	23.135,93	642,29	6,50	4.423.467	2.750,08
Lazio	1.100,68	16.123,93	7,23	6,39	5.892.425	5.353,45
Liguria	304,58	5.031,64	79,92	5,71	1.583.263	5.198,23
Marche	513,71	8.883,29	4,19	5,47	1.550.796	3.018,84
Sicilia	1.369,18	24.310,93	151,91	5,33	5.092.080	3.719,06
Toscana	1.156,12	21.802,56	27,91	5,04	3.752.654	3.245,90
Umbria	336,96	8.125,52	1,64	3,98	894.762	2.655,38
Calabria	583,52	14.507,35	130,74	3,87	1.976.631	3.387,42
Abruzzo	390,27	10.389,58	51,64	3,62	1.331.574	3.411,89
Trentino-Alto Adige	348,18	12.899,95	356,59	2,63	1.055.934	3.032,71
Molise	115,16	4.312,84	32,44	2,60	313.348	2.721,04
Sardegna	590,27	23.467,50	41,99	2,45	1.663.286	2.817,86
Basilicata	228,55	9.843,26	1,30	2,27	576.619	2.522,91
Valle D'Aosta	53,58	3.197,46	9,81	1,65	128.298	2.394,37

Graph 3 Built-up and not built-up land of all Italian regions, in total and percentage. Columns 2-5 are by ISPRA 2015 (data 2012). Column 6 is by ISTAT 2015. Column 7 is a derived calculation by the authors

REGION	BUILT-UP LAND [%] 1956	BUILT-UP LAND [%] 1989	BUILT-UP LAND [%] 2012	CHANGE 1956-2015 [%] (AUTHORS)
Lazio	1,86	5,43	6,39	242,76
Emilia-Romagna	2,39	6,67	7,32	205,87
Sicilia	2,08	5,49	5,33	155,80
Veneto	3,90	6,07	9,52	144,11
Umbria	1,69	3,42	3,98	135,08
Abruzzo	1,62	3,51	3,62	123,28
Friuli Venezia Giulia	2,99	5,35	6,68	123,10
Toscana	2,28	4,60	5,04	120,70
Piemonte	3,04	5,36	6,50	113,93
Lombardia	4,86	7,91	10,39	113,84
Liguria	2,76	5,12	5,71	106,86
Marche	2,73	4,83	5,47	99,92
Puglia	3,42	6,24	6,67	94,84
Campania	4,49	7,12	8,33	85,59
Trentino-Alto Adige	1,49	2,10	2,63	76,90
Calabria	2,37	3,93	3,87	63,30
Sardegna	1,66	2,63	2,45	47,45
Molise	2,01	2,91	2,60	29,39
Basilicata	2,25	2,96	2,27	0,94
Valle D'Aosta	1,71	2,39	1,65	-3,62

Graph 4 Share of built-up land referring to the calculations of 1956, 1989 and share of variation of built-up land between 1956 and 2012. Columns 2 and 3 by Rete di monitoraggio del consumo di suolo, ISPRA 2015. Column 4 by ISPRA 2015. Column 5 calculation by authors

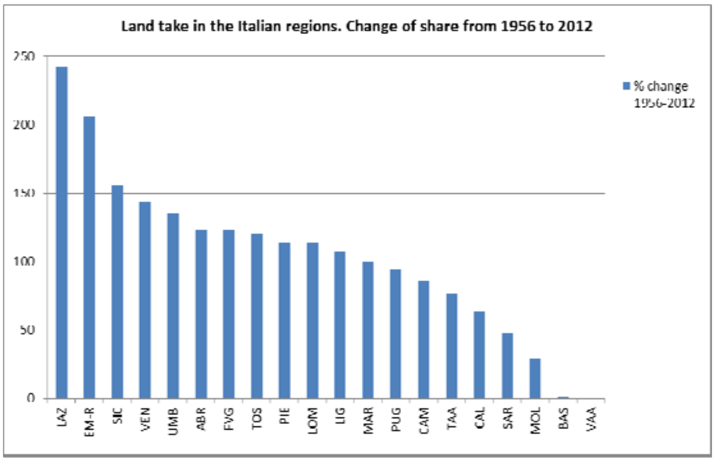

Chart 6 Share of variation of built-up land between 1956 and 2012. Calculation by authors

3.2 THE REGION CAMPANIA AND IT'S PROVINCES

Campania is affected by a number of disorders due mostly to the distribution of the population. There are more explanations for these disorders such as morphological causes: a belt of coastal plains is a counterpoint to an internal land mostly composed by hills, with a relevant presence of mountain systems. All of these considerations can be found in the data on the land take phenomenon in these areas.

Graph 5 underlines the importance of this process in Naples' province, both in percentage (29,51%) and absolute values. High values are present both in Caserta's districts (8,03) and in Salerno (6,53). Relevant values have been found also in the provinces of Avellino (5,47) and Benevento (5,22), comparable to the national average.

PROVINCE	BUILT-UP LAND [HA]	NOT BUILT-UP LAND [HA]	NOT CLASSIFIED AREAS [HA]	BUILT-UP LAND [%]	NOT BUILT-UP LAND [%]	NOT CLASSIFIED AREAS [%]
Napoli	34.793,90	83.099,87	0,00	29,51	70,49	0,00
Caserta	21.234,99	243.193,00	699,64	8,03	91,97	0,26
Salerno	31.429,70	463.489,73	485,68	6,35	93,65	0,10
Avellino	15.341,20	265.239,85	15,42	5,47	94,53	0,01
Benevento	10.794,92	195.837,80	1.404,22	5,22	94,78	0,67

Graph 5 Total and share of Built-up land in the provinces of the region Campania. Ordered by the share of built-up land. Data related to 2012 by ISPRA 2015.

PROVINCE	BUILT-UP LAND [KM2]	RESIDENT POPULATION (2015, ISTAT)	RESIDENT POP. / BUILT-UP LAND (AUTHOR)
Napoli	347,94	3.118.149	8.962
Caserta	212,35	924.592	4.354
Salerno	314,30	1.108.509	3.527
Avellino	153,41	427.936	2.789
Benevento	107,95	282.321	2.615

Graph 6 Resident population by unit of built-up land in the provinces of Campania. Column 2 by ISPRA 2015. Column 3 by ISTAT 2015. Column 4 by authors

In general, the province of Naples is affected by the largest amount of built-up land, followed by the province of Salerno, which values are really close to those registered by Naples. The vast extension of this region helps reduce the share values. If the same indicator used for the regions is applied to the Neapolitan provinces (resident population/ built-up land) the variability arises (Graph 6). It is to keep in mind that the regional values were already higher than the national average which affects the provinces' values, especially that of Naples. Even Caserta and Salerno have values higher than the national average while Avellino and Benevento have lower values.

Looking to municipal data, Graph 7 shows the distribution and the trend of the share of built-up land for the districts in Campania (551). The chart shows the deep difference between the highest value (Casavatore 85,35%) and the lowest (Valle dell'Angelo 0,41%).

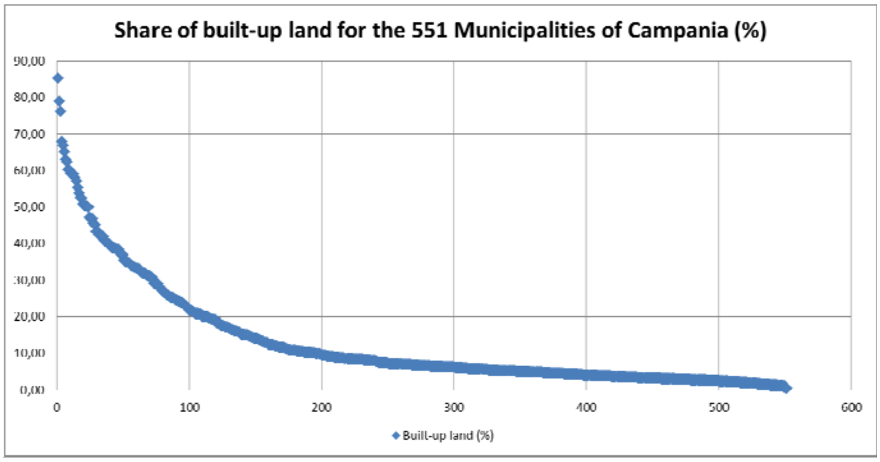

Chart 7 Distribution of the trend of land use in percentage for the Campania's 551 municipalities

PROVINCE	MAX BUILT-UP LAND [%]	MIN BUILT-UP LAND [%]	MAX – MIN DIFFERENCE (AUTHORS)
Avellino	26,52	1,18	25,34
Benevento	17,00	1,16	15,84
Caserta	60,02	1,27	58,75
Napoli	85,35	6,40	78,95
Salerno	39,67	0,41	39,26

Graph 7 Maximum and minimum share of built-up land in the municipalities of Campania and their difference. Data by province. Column 2 and 3 by ISPRA 2015. Column 4 by authors

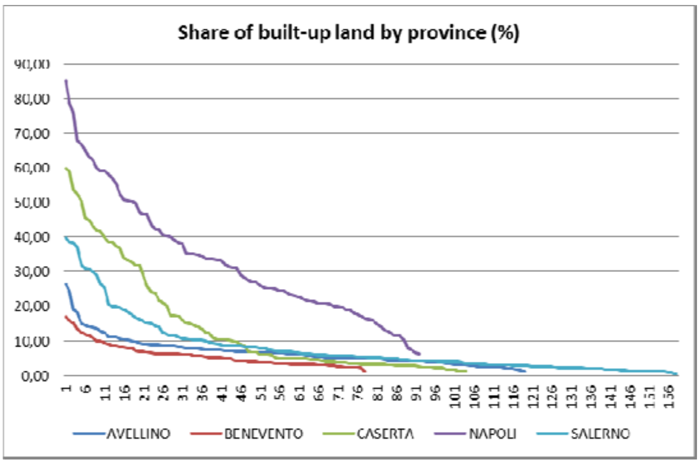

Chart 8 Distribution of share of built-up land in the municipalities of the five provinces of Campania

The distribution of the built-up land sees the districts from the province of Naples and Caserta in the first places, those of Avellino and Benevento at the end (on a national classification the first 15 places belong for

11 to the province of Naples and other 2 to the province of Caserta). The province of Salerno is in the middle with a wider extension.

Furthermore, Graph 7 shows how the distribution of built-up land has its greatest variability between the provinces of Naples and Caserta while it is more stable in those of Avellino and Benevento. Chart 8 represents the graph of distribution for each province.

4 LAND TAKE IN THE METROPOLITAN AREA OF NAPLES. THE "RESIDUAL LAND"

In a recent publication, Papa & Mazzeo (2014) have underlined the changes in the territorial system of the metropolitan area of Naples. The research analysed the evolution of the resident population from the late 1800's to 2001 in the districts belonging to the suburbs around Naples. The paper assumes an area that contains all the municipalities of the Naples' province, with the addition of a number of municipalities belonging to the provinces of Caserta and Salerno. This choice was not an attempt to define a new urban boundary, but the answer to the need of defining a territory in which to deeply analyse the urbanization process. Moreover, this wider extension includes areas with strong functional relations with Naples. For the opposite reason, we think that a boundary matching with the Province of Naples is highly reductive.

For these reasons the spatial analysis reported in the study starts by choosing a study area consistent with the physical and functional characteristics of the Neapolitan conurbation but without any actual relapse in administrative terms. It is a space that includes 142 Municipalities belonging to the provinces of Naples, Caserta, and Salerno (Chart 9). These municipalities were assigned to five belts roughly concentric, with Naples at the core pole. The correspondence of the 142 Municipalities to the 6 areas (1 core and 5 belts) is made according to the criterion of the geographical proximity. Starting from Naples (core 0), belt 1 contains the closest Municipalities, and so on up to the fifth belt formed by the insular municipalities of the Naples Gulf and by the farthest localities of the Sorrentina Peninsula.

To analyze this territorial system, the database has been enriched with elements contained in the database from ISPRA 2015 and updated to the population up to 2015 and with the data from the agricultural census of 2010. Graph 8 shows the summary of the land use values for each belt, in percentage and absolute value, and the data relating to the ratio between resident population and built-up land.

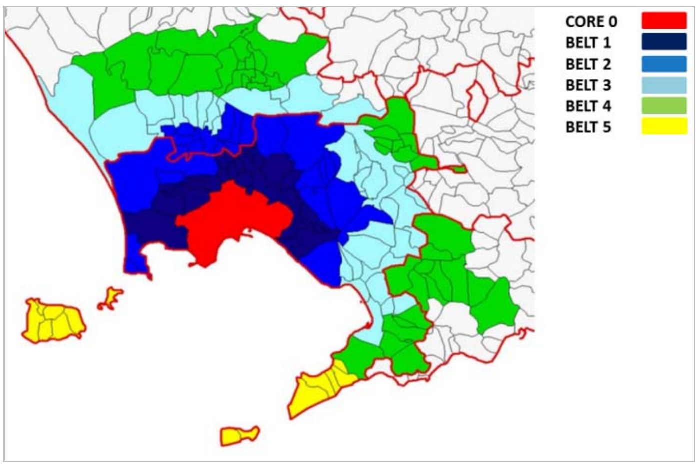

Chart 9 Metropolitan area of Naples studied by Papa & Mazzeo, 2014

A first consideration that can be made refers to the fact that going from Naples towards the outer suburbs the value of built-up area diminishes, with a growth in the 5th belt. The interpretation of the use of land in absolute values is completely different and obviously determined but the territorial characteristics of each belt.

	LAND AREA [HA] (ISTAT)	POPULATION 2015 (ISTAT)	BUILT-UP LAND 2012 [HA] (ISPRA 2015)	BUILT-UP LAND 2012 [%] (ISPRA 2015)	RESIDENTIAL POP. / BUILT-UP LAND [AB/HA] (AUTHORS)
Core 0 (1)	11.727	978.399	6.783,42	57,84	144,23
Belt 1 (27)	21.376	919.357	8.968,31	41,96	102,51
Belt 2 (25)	39.116	719.812	10.034,43	25,65	71,73
Belt 3 (35)	56.180	643.616	12.491,58	22,23	51,52
Belt 4 (40)	65.730	677.022	11.188,14	17,02	60,51
Belt 5 (14)	10.408	149.871	2.491,02	23,93	60,16
Metro Area	**204.537**	**4.088.077**	**51.956,90**	**25,40**	**78,68**
Campania	1.367.095	5.861.529	113.595,00	8,33	51,60
Italia	30.134.000	60.794.612	1.751.127,00	5,81	40,40

Graph 8 Metropolitan area of Naples in the organization analyzed by Papa & Mazzeo, 2014. Columns 2 and 3 by ISTAT. Columns 4 and 5 by ISPRA 2015 (data 2012). Column 6 by authors

The cross-reading of the values confirms the phenomenon of urban sprawl that has occurred in the plain of the region Campania, especially in the belts from 1 to 4 and it confirms that this phenomenon has occurred with a decrease in the population's density which is typical of urban sprawl. There is, in fact, a flow from 144,23 inhabitants for each acre of used land in the central area to 51,5 in belt 3 and 60 in belt 4 and 5. Graph 9 indicates the values of the total of farming land in 1982 and 2010 calculating the difference between the two years in percentage. It is important to underline the loss of farming land in these 28 years, going from 37% in belt 4 to 67% in belt 1. The average of the loss of farming land was 44,34% with the highest values in belt 2, 5 and 1. Again it is pointed out how the loss of farming area is higher in the central belts rather than the ones outer in the suburbs with the exception of belt 5, which has its own characteristics. It is in fact composed by municipalities with a high touristic affluence so the loss of farming area is due to the development of touristic activities more than the closeness to the city of Naples.

	TOTAL FARMING AREA 1982 (Ha) (ISTAT)	TOTAL FARMING AREA 2010 (Ha) (ISTAT)	FARMING AREA CHANGE 2010-1982 (%)
Core 0 (1)	2.319,69	1.063,69	-54,15
Belt 1 (27)	9.797,85	3.214,61	-67,19
Belt 2 (25)	24.639,71	12.847,07	-47,86
Belt 3 (35)	31.873,55	19.215,86	-39,71
Belt 4 (40)	40.178,74	25.218,67	-37,23
Belt 5 (14)	5.133,08	1.865,86	-63,65
Metro Area	**113.942,62**	**63.425,76**	**-44,34**

Graph 9 Metropolitan area of Naples in the organization analyzed by Papa & Mazzeo, 2014. Trend of the total farming area 1982-2010. Columns 2 and 3 by ISTAT 2010. Column 4 by authors

At this point, it can be interesting to combine both the data from ISPRA and that of ISTAT starting from the following characterizing data:

- the value of land area, which is an official value;
- the value of built-up land, referred to 2012 but published by ISPRA in 2015;
- the value of farming land, as certified in the Agricultural Census of ISTAT (2010).

The mathematical combination of these three indicators creates a fourth indicator which can be referred to as "Residual Land", calculated by subtracting the amount of farming land (ISTAT, 2010) and the urbanized land (data 2012, ISPRA, 2015) to the total land area.

Two methodological issues are important to be underlined. The first one relates to the difference between the years the data was taken (2012/2010) even if they are close, it can so be hypothesized that the two time periods can be related in the same formula. The second and the maybe more important issue is the fact that the data comes from two different sources that might have used different methods to achieve it. Chart 10 illustrates graphically the process while Graph 10 shows the results obtained for each belt.

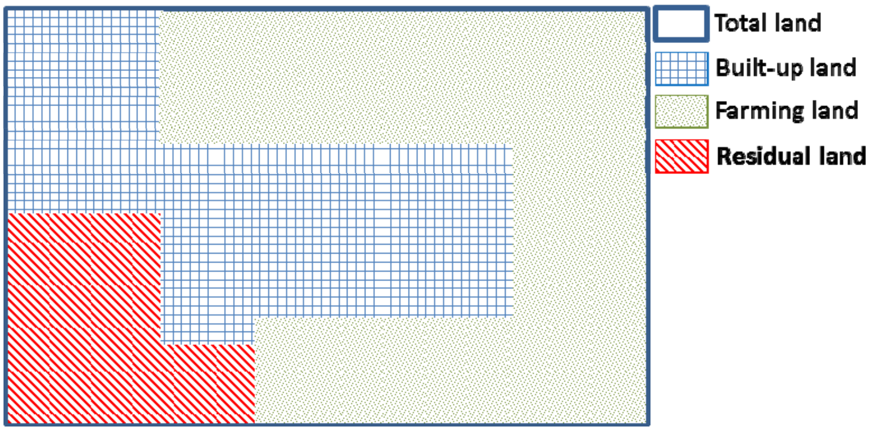

Chart 10 Residual land as difference of built-up land and farming land

The category of the residual land is of great interest and there are many possible considerations that can be made on it. It includes different kinds of land such as completely unavailable lands (constrained areas, regional or national parks, areas with an hydrogeological constrained) or areas with a major availability and areas that have been completely abandoned waiting for a new employment which would be more remunerative. Graph 11 shows the different not built-up area categories by ISPRA 2015 and their division in the two categories of farming land and residual land. The division is the same shown in Graph 2.

	(A) TOTAL LAND AREA (HA)	(B) BUILT-UP LAND, ISPRA (2012, HA)	(C) FARMING LAND, ISTAT (2010, HA)	RESIDUAL LAND, AUTHORS (RL=A-B-C, HA)	RESIDUAL LAND, AUTHORS (RL, %)
Core 0 (1)	11.727,00	6.783,42	1.063,69	3.879,89	33,09
Belt 1 (27)	21.376,00	8.968,31	3.214,61	9.193,08	43,01
Belt 2 (25)	39.116,00	10.034,43	12.847,07	16.234,50	41,50
Belt 3 (35)	56.180,00	12.491,58	19.215,86	24.472,56	43,56
Belt 4 (40)	65.730,00	11.188,14	25.218,67	29.323,19	38,37
Belt 5 (14)	10.408,00	2.491,02	1.865,86	6.051,13	58,14
Metro Area	204.537,00	51.956,90	63.425,76	89.154,34	43,59

Graph 10 Metropolitan area of Naples in the organization analyzed by Papa & Mazzeo, 2014. Absolute and per cent values of Residual land. Columns 2 by ISTAT. Column 3 by ISPRA 2015. Column 4 by ISTAT 2010. Column 5 and 6 by authors

The table 11 is built on the finding that in the category of non-built areas are classified a number of areas between them very different. Some of them fall into the category of agricultural land, while others can be classified as Residual Lands. Furthermore, it is evident how the Residual Lands may also be divided into two categories in relation to the environmental significance which they are constituted: the higher this significance, the higher the level of protection which must be subjected.

The interest in the residual areas is that the size of the areas of this category is relevant. The metropolitan area is composed by 90.000 hectares that are part of this category, with the percentage of almost 50% in the central nucleus (0) and in the outer belts. The need of an in-depth analysis is clear to improve the knowledge on the characteristics of this category, defining precisely the number of subcategories that compose it and their extension. This analysis can also be considered as a major proof of the sizes considered: the sum of each category has to result in the value of the total land area. This means that if the sum results in less than the total then some parts have been left out while if it results as a higher number than the territory this would mean that some parts have been counted more than once, being this hypothesis more realistic than the other.

NOT BUILT-UP LANDS (ISPRA, 2015)	FARMING LANDS	RESIDUAL LANDS	ENVIRONMENTAL SIGNIFICANCE OF THE RESIDUAL LANDS
Trees or shrubs in urban areas	=	**SI**	**Medium-low**
Trees or shrubs in farming land	SI	**=**	
Trees or shrubs in natural areas	=	**SI**	**High**
Areas for planting	SI	**=**	
Meadows, grass vegetation	SI	**=**	
Water plants	=	**SI**	**High**
Riverbeds	=	**SI**	**High**
Wetlands	=	**SI**	**High**
Rocks, soil, sand, dunes	=	**SI**	**High**
Glaciers and areas with permanent snow	=	**SI**	**High**
Non waterproof sports areas	=	**SI**	**Low**
Non waterproof urban areas	=	**SI**	**Medium**
Non waterproof farming areas	SI	**=**	
Non waterproof natural areas	=	**SI**	**High**

Graph 11 Not built-up land kinds by ISPRA, 2015 and their differentiation in farming land and residual land

In this analysis, a special thought has to be done on the farming land. The paper has considered these areas as a specific category, based on the importance this land has and the fundamental necessity that none of it must be lost. On the other hand, the trend from 1982-2010 shows a constant reduction of farming soil which seems to still occur (Di Marco, 2010). The farming land has in fact suffered from relevant loss in absolute value, reducing its extension of 90% in some areas as it is considered being economically less important and the easiest to be transformed. As to this an intervention to protect and a reclassification of the farming land is imminent.

If you observe the data it is clear that the reduction of the agricultural area is not due only to its transformation in built-up area. A part of it, indeed, is transformed back into the natural or seminatural land (Arcidiacono, 2011). This is due to a long period of agricultural crisis, as it continuously lost employees and produced less. This resulted in the abandonment of the production sites and in their slow transformation into natural areas or building areas. This phenomenon is relevant especially in the internal areas of the Appennini. Other than some appositions to the limitations of farming land use, a second possibility would return the land to agriculture working on the opportunities the "farm to table" offers as these areas are close to big urban systems. This possibility depends on the size of the land that will be re-naturalize (from which comes the possibility to create urban gardens other than more extended farms), but it mainly depends from the willing of sponsors to invest on agriculture so to increase its occupational power.

In conclusion, the area considered "farming area" is not free from waterproofing that are easily noticeable with ISPRA's optical techniques. This means that a number of these territories have been classified by ISPRA as used land while ISTAT classified them as farming land. More details can be reached if we consider not only the farming land but farming land actually used.

5 CONCLUSION

This paper has analyzed the phenomenon of land take in the metropolitan area of Naples underlining how the extension of the phenomenon, already high in the rest of the country, tends to multiply in the area analyzed, both for historical (urbanization started long ago) and social reasons (the construction of building both legal and illegal is a basis of the local economy). This leads to the absence of reliable tools for urban and territorial planning.

The first part of the paper has introduced the concept of land use finding its negative aspects regarding biological, economic and social balance. This phenomenon exists because of the little consideration given to the natural land and to the complex processes it takes part to.

The analyses have underlined the areas with a major value of land use focusing on the metropolitan area of Naples. This area encloses many kinds of areas all negatively impacted by land use. These kinds would be agricultural area which is of high quality, incredible landscape, and a high life quality in the metropolitan area that has incredibly diminished.

The third part has underlined an interesting data that needs to be analyzed more in depth. The difference between farming land and built-up land results in an area of residual land of great extension with many different characteristics and that could represent the area where the phenomenon of land consumption most occurs. For this reason, Graph 10 shows a first hypothesis of critical issues in residual lands. This analysis hypotheses levels of critical issues based on the higher or lower risk that the area considered can be used again. This was of thinking needs an insight as there is a difference between a land's classification and the laws that regulate its transformation into something else. We could create two different layers if we wanted to classify different areas for their potentialities and the effective transformations that can be done. Layer 1 would be made by all the transformations allowed by the laws and by classification rules which are established by complex political and technical compromises. On the other hand, Layer 2 would be made up of all the transformations really done on the territory which have followed or not the rules present in Layer 1. Layer 1 and Layer 2 together can tell us details about how much of the land use is truly legal and the level of respect for the territory. This shows how important the union of the two layers is and how useful cutting down on layer 1 would be to prevent future land consumption.

In regards of national and regional territories, the paper has pointed out an already known detail: the continuous loss of agricultural land both in absolute and percentage and the need of containment so to prevent a future transformation of these areas in urbanized land.

Regarding already built-up land, it is useful to find parts of it that can realistically be qualified and where new buildings can be edified without using more land.

In conclusion, the importance of the phenomenon of land take has reached a terrifying peak in the metropolitan area of Naples. For this reason, it is important not to lose any more natural and agricultural land, but without precluding the possibility of a turn of trend where there can be a renaturalization of big portions of land.

Notes
Although the paper grounds on a common research work, paragraph 2 has been written by L. Russo, paragraph 3 by G. Mazzeo and paragraphs 1, 4 and 5 have been written by G. Mazzeo & L. Russo.

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IMAGE SOURCES

Paper main image: by Giuseppe Mazzeo, all rights reserved. Chart 1-10: by Authors.

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REVIEWS PAGES

EXTREME WEATHER EVENTS CAUSED BY CLIMATE CHANGE

Starting from the relationship between urban planning and mobility management, TeMA has gradually expanded the view of the covered topics, always remaining in the groove of rigorous scientific in-depth analysis. During the last two years a particular attention has been paid on the Smart Cities theme and on the different meanings that come with it. The last section of the journal is formed by the Review Pages. They have different aims: to inform on the problems, trends and evolutionary processes; to investigate on the paths by highlighting the advanced relationships among apparently distant disciplinary fields; to explore the interaction's areas, experiences and potential applications; to underline interactions, disciplinary developments but also, if present, defeats and setbacks.
Inside the journal the Review Pages have the task of stimulating as much as possible the circulation of ideas and the discovery of new points of view. For this reason the section is founded on a series of basic's references, required for the identification of new and more advanced interactions. These references are the research, the planning acts, the actions and the applications, analysed and investigated both for their ability to give a systematic response to questions concerning the urban and territorial planning, and for their attention to aspects such as the environmental sustainability and the innovation in the practices. For this purpose the Review Pages are formed by five sections (Web Resources; Books; Laws; Urban Practices; News and Events), each of which examines a specific aspect of the broader information storage of interest for TeMA.

01_WEB RESOURCES
The web report offers the readers web pages which are directly connected with the issue theme.

author: Chiara Lombardi
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02_BOOKS
The books review suggests brand new publications related with the theme of the journal number.

author: Gerardo Carpentieri
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03_LAWS
The law section proposes a critical synthesis of the normative aspect of the issue theme.

author: Laura Russo
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04_URBAN PRACTICES
Urban practices describes the most innovative application in practice of the journal theme.

author: Gennaro Angiello
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05_NEWS AND EVENTS
News and events section keeps the readers up-to-date on congresses, events and exhibition related to the journal theme.

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01_WEB RESOURCES
网站报告为读者提供与主题直接相关的网页。

author: Chiara Lombardi
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02_BOOKS
书评推荐与期刊该期主题相关的最新出版著。

author: Gerardo Carpentieri
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03_LAWS
法律部分提供主题相关标准方面的大量综述。

author: Laura Russo
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04_URBAN PRACTICES
城市的实践描述了期刊主题在实践中最具创新性的应用。

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05_NEWS AND EVENTS
新闻与活动部分让读者了解与期刊主题相关的会议、活动及展览。

author: Andrea Tulisi
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01

EXTREME WEATHER EVENTS CAUSED
BY CLIMATE CHANGE

REVIEW PAGES: WEB RESOURCES

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In this number

WHAT ARE CITIES REALLY DOING TO TACKLE CLIMATE CHANGE?

Climate change is undeniably one of the greatest challenge of the 21st century. The Fifth Assessment Report of the Intergovernamental Panel on Climate Change, presented in Stockholm in 2013, pointed out that global warming is unequivocal and that since the 1950s many of the observed changes are unprecedented over the past millennia. Moreover, the report confirms it is "extremely likely" that human activities have caused this exceptional rise in global temperature, due to the concentration of carbon dioxide in the atmosphere, almost entirely related to the burning of fossil fuel and deforestation (IPCC, 2013). Unquestionably, cities play a determinant role since more than the 50% of world's population lives in urban areas. Indeed, they are responsible for 75% of global greenhouse gas emissions, with transport and buildings being key contributors (UNEP). On the other hand, cities are the most vulnerable places to the effects of climate change, if we consider the share of population living and also the quantity and quality of economic activities exposed (Galderisi, 2014). In addition, the specific urban texture can increase some climate-related phenomena, causing serious problems to the livelihood of the population (Stone et al., 2010). In order to face such a threat to human civilization, major efforts have been addressed to reduce urban vulnerability and to increase cities' recovering capacity. In this context, there is an ever-increasing need for global and local policies to enhance urban resilience at different scales, taking into consideration both the mitigation and the adaptation strategies. Many communities all over the world have taken up the challenge, outlining combined strategies to cope with disastrous events such as floods, droughts, sea level rise, but also non-climate-related events such as earthquakes and volcanic eruptions. With the aim of giving a wide panorama of the actions undertaken by academia, international organizations and local communities, this section presents three websites: Climate-KIC, EU Commission's Climate Action and 100 Resilient Cities. The Climate-KIC is Europe's largest public-private partnership focusing on Climate Change, consisting of academic institutions, public sector and companies. The second webpage is the portal of the Directorate General for Climate Action of the European Commission, whose aim is to lead EU's efforts to tackle climate change at international level. The last website presented is a virtual hub to support the adoption and incorporation of a view of resilience within urban policies. Pioneered by the Rockefeller Foundation, 100 Resilient Cities is dedicated to helping cities around the world to improve resilience measures and to share them with each other.

CLIMATE-KIC

http://www.climate-kic.org/

The Climate-KIC is a community of researchers, public institutions and companies whose common aim is to support climate change mitigation and adaptation. Created in 2010 by the European Institute of Innovation and Technology (EIT), as one of the three Knowledge and Innovation Communities (KICs), it now represents one of the EU's largest hub for students, entrepreneurs and public bodies to exchange knowledge and turn creative ideas into economically viable products or services in the field of green economy.

Composed of 13 European centers, each managed by a director, Climate-KIC is a non-profit association, receiving funding from academic and private sector partners, as well as grants from the European Commission. Its vision is to enable Europe to lead the global transformation towards sustainability through innovative projects, often developing new products or services, taking them to market through existing businesses or spin-off companies.

The webpage is user-suited for different profiles, offering several services. Entering student's section, a wide range of educational opportunities are offered: students are given the chance to deepen their knowledge and develop their own business in the green sector: Master's Degree, PhDs, Summer schools and Business education opportunities are available. The entrepreneur section is dedicated to help people transform innovative ideas into business products and services. This section provides business accelerator, idea competitions, courses, placement programs. Whereas, the businesses section is meant to bring together partners to find climate-friendly solutions, linking suppliers to end-users. For public bodies, Climate KIC offers special support not only to combat climate change but also to create economic opportunities for cities and regions. The community addresses climate change across four priority themes: urban areas, land use, production systems, climate metrics and finance.

The leitmotif is education, in the belief that young people are the next generation of climate leaders. For instance, students are offered the opportunity to have a journey in one of the European country to integrate a Master program or simply for a couple of weeks in summer schools.

As regards projects, there is a variety of themes and goals to accomplish. For instance, “Adaptation tool for local authorities” and “Adapting water use in the agricultural sector” aim at implementing adapting measures at local scale, working side by side with Local Bodies, companies and farmers organizations. Conversely, some other projects are oriented towards developing models to predict future scenarios and outlining strategies. “Behavioral change for sustainable urban mobility” and “Open access catastrophe models” fall within this group: the first is focused on developing business models to engage the private sector in sustainable urban mobility, the latter provides a new open-source model to tackle natural disasters, by addressing the uncertainty and the setbacks of the existing models.

To sum up, climate change is such a challenge that regions cannot face alone. Countries are becoming aware that being in a community is compulsory to make the measures effective. Indeed, there is a need for multidisciplinary integration of adapting and mitigation actions in each European territory in order to outline effective strategies to reduce global warming and its consequences. In this context, Climate-KIC is an interesting experiment of multicultural interdisciplinary partnership focused on climate change mitigation and adaptation.

CLIMATE ACTION
http://ec.europa.eu/clima/

Climate Action is the official website of the Directorate-General for Climate Action (DG CLIMA) of the European Commission, whose mission is to formulate and implement policies and strategies at EU and international level to fight climate change. The website collects all the documents about EU strategies, international negotiations, emission trading systems and reports about emissions monitoring in the European territory. It is structured into seven sections: Home - About us - Climate Change - EU Action - Citizens - News&Your voice - Contact&Grants. The first section gives a panorama of what you are expected to see in the following pages, such as news and highlights. The second section describes what the DG CLIMA for European Commission does to face climate change and what are the main issues it deals with. "Climate Change" section provides a useful summary of the main climate change consequences and climate-related catastrophic events due to human activities. "EU Action" section is the highlight of the website: it collects the foremost strategies developed by the EU and the targets set in the very next future to lead Europe towards a low- carbon economy. In particular, there are insights of the key targets set by the EU for the 2020 and 2030, described in detail in the 2050 low-carbon roadmap. In detail, the 2020 package is a combination of regulation to ensure that the EU meets three key targets for the 2020:

- 20% of reduction in GHG emissions (from the 1990 level);
- 20% of total energy consumption from renewable;
- 20% improvement of energy efficiency in buildings, transportation and industry.
- The package includes also special targets for social inclusion and smart growth.
- The 2030 strategy sets three key targets as well, but the achievements are far more ambitious:
- At least 40% of reduction in GHG emissions (from the 1990 level);
- At least 27% of total energy consumption from renewable;
- At least 27% improvement of energy efficiency.

This strategy is meant to go further the 2020 package and lead the EU towards a competitive low carbon economy in 2050, as stated by the Roadmap for low carbon Economy 2050, Energy Roadmap 2050 and the Transport White paper. This section provides also a special area where documents are available to download: EU conclusions, communication, assessments, reports, green paper and so on.
"Citizens" section offers the ordinary citizen a shortcut to EU information, giving explanation for the key issues related to climate change and providing a full overview of EU policies and long-term goals. In particular, this section also has videos about each topic and useful links to follow up on the questions.
"News&Your voice" section collects the latest news regarding international regulations, agreements, council calls, consultations, conferences, release of new reports and any useful information for people and stakeholders involved in the green sector. The last section, "Contacts&Grants" is dedicated to those interested in a partnership agreement with the Directorate-General or applying for funding. Indeed, here is provided a list of contracts and grants made available for companies or organizations who want to work with the EU offices in projects to combat climate change. To conclude, EU commission's Climate Action is an official web-resource where people interested in learning more about climate change and European policies can find a wide panorama, where news about climate actions are always updated and where companies and organizations are informed about the latest calls for partnership.

100 RESILIENT CITIES
http://www.100resilientcities.org/

100 Resilient Cities (100 RC) is a website dedicated to helping urban areas around the world became more resilient to physical, economic and social challenges related to climate change hazards but not only. The Rockefeller Foundation has been financing this project since 2013, when it first started working 32 cities, receiving 330 applications in 2014, and achieving the successful accomplishment of 100 cities in 2015.

100 RC's aim is to support the adoption of a view of resilience within cities' policies, that includes natural hazards such as earthquakes, floods, droughts, volcanic eruptions but also other threats related to human activities and social organization. In other words, it emphasizes the stresses that weaken fabric of a city on a day to day, such as: high unemployment, an overtaxed or inefficient public transportation system etc. 100 RC works in the direction of addressing both the shocks and the stresses, in order to help cities become more able to respond to adverse events, so they are overall better able to deliver basic functions in both good times and bad, to all populations. Cities applying for 100 RC network are expected to receive special support to develop their own roadmap to resilience along four main pathways:

- financial and logistical support to establish a Chief Resilience Office within the city government;
- expert support to develop a robust resilience strategy;
- access to a wide network of partners from the private, public and NGO sectors;
- enter an international network where each city can upload its strategy and share them with each other.

Basically, to promote a resilience view, 100 RC set challenges for cities to demonstrate which are the most 100 resilient cities in the world, in some specific ambits. For instance, Bristol proved to have outlined a successful strategy to fight food shortage; Da Nang, Mandalay, New Orleans, New York City, San Juan and Tulsa have performed effective policies to address tropical storms.

In conclusion, 100 RC represents a successful experience of cities involved in the process of sharing information and expertise to increase the overall knowledge on adaptation and mitigation to natural and anthropic hazards, providing cities all over the world with the skills to fight the challenges of tomorrow.

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IMAGE SOURCES

The images are from: www.planningclimatechange.org/; http://www.climate-kic.org/; http://ec.europa.eu/clima/; http://www.100resilientcities.org/.

02

EXTREME WEATHER EVENTS CAUSED BY CLIMATE CHANGE

REVIEW PAGES: BOOKS

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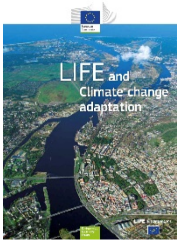
In this number
ADAPTATION TO CLIMATE CHANGE

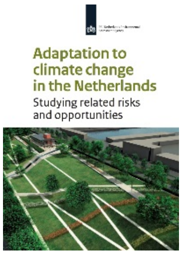
The climate change is a strong challenge for cities around the world, especially in developing countries where urbanization is proceeding at high speed. In the last years to building resilience and adapting to climate change is increasingly a high priority for urban areas. Besides mitigation, on which efforts have largely focused in the past, cities should today play a larger role in adaptation. The Climate change impacts range from an increase in extreme weather events and flooding to hotter temperatures and public health concerns. The urban areas in low-elevation coastal zones, for instance, face the combined threat of sea-level rise and storm surges. The individual impacts on each urban area will depend on the actual changes in climate experienced, which will vary from location to location. The urban areas face important consequences of climate change, both now and into the future. These impacts have theoretically serious consequences for human health, livelihoods, and assets, especially for the urban poor area, informal settlements, and other vulnerable groups.

The governments often lack powers to raise the revenues required to finance infrastructure investments and address the climate change agenda. When governance capacity is weak and constrained, cities are limited in their abilities to take programmatic action on climate change mitigation and adaptation (McCarney et al., 2011). Although progress is being made, leaders of urban areas are not usually at the table when international protocols and agreements on climate change are discussed by member states and when states decide on whether to sign and support these international agreements. The vulnerability of urban areas to climate change risks is largely underestimated in these negotiations. Without established data and standardized indicators on climate change, it is more challenging for urban areas to enter into these global discussions. With increasing urban vulnerability being recognized however, estimated simply by the fact of the increasing dominance of city dwellers worldwide and the increasing visibility of climate change vulnerabilities in cities, it has become more pressing for governments of urban areas to be considered as new sites of governance in global negotiations on climate change and in decision-making related to risk assessments. According to these considerations, this section suggests three books that help to better understand the issue of this number: LIFE and Climate change adaptation; Adaptation to climate change in the Netherlands Studying related risks and opportunities; US Housing and urban development climate change adaptation plan.



Title: LIFE and Climate change adaptation
Author/editor: Environment and Climate Action Directorates-General
Publisher: EU
Download:n.d.
Publication year: 2015
ISBN code: 978-92-79-52307-6

The European Structural and Investment Funds represent more than 43% of the EU 2014-2020 budget. These founds have a significant role to play in reaching the "at least 20%" overall target for climate related expenditure and contribution to Europe's transition to a low carbon and climate-resilient economy. From the preliminary data shows that the overall share of climate-related expenditure in the indicative European Structural and Investment Funds budget for 2014-2020 will be about 25%. This money will support such climate change-related actions as development of renewable energy sources, energy efficiency, sustainable urban mobility, climate adaptation measures, green infrastructure, ecosystem services, sustainable agriculture and forestry, climate-related innovation, business development and green jobs. The EU Strategy on adaptation to climate change, adopted by the European Commission in April 2013, sets out a framework and mechanisms for taking the EU's preparedness for current and future climate impacts to a new level. This strategy has three objectives: Encourages all Member States to adopt comprehensive adaptation strategies and will provide guidance and funding to help them build up their adaptation capacities and take action; Promoting better informed decision-making by addressing gaps in knowledge about adaptation and further developing the European Climate Adaptation Platform; Promoting adaptation in key vulnerable sectors through agriculture, fisheries and cohesion policy, ensuring that Europe's infrastructure is made more resilient, and encouraging the use of insurance against natural and manmade disasters. Furthermore, the implementation of the EU Adaptation Strategy is based on eight actions. One of these actions expected to provide new LIFE funding to support capacity building and step up adaptation action in Europe (2014-2020).
The LIFE has been one of the main funding sources for demonstration projects that have facilitated the implementation and enforcement of EU climate adaptation policy and mainstreamed adaptation in many other policy areas. Since 2000, the LIFE programme has co-financed nearly 150 projects that focus on climate change adaptation topics. This programme, in these years, has mobilised some € 307 million for climate change adaptation (with an EU contribution of €152 million). The LIFE has helped mainstream adaptation in many policy areas, bringing stakeholders together to work on common objectives and raising awareness on adaptation issues. The programme has been most active in mainstreaming climate adaptation in water policy (43 projects), including a strong focus on water scarcity and floods; in agriculture (25 projects); and in creating resilient urban and suburban areas (22 projects). The implementation of adaptation policies and measures is still at a relatively early stage. This, together with the need to maintain political commitment to adaptation and related expenditure, makes it imperative to understand which adaptation actions work in which contexts and to know the reasons why.
The LIFE 2014-2020 funding can support projects that help monitoring and assess the progress of adaptation measures. To do this, proxies for measuring "reduced vulnerability" or "increased resilience" will have to be developed. Projects can also help in developing indicators that provide evidence that a certain condition exists or certain results have or have not been achieved. The current funding period offers significant scope to finance projects that improve or extend best practices developed by earlier LIFE projects in areas such as adaptation planning, forestry practices or green/blue infrastructure.



Title: Adaptation to climate change in the Netherlands Studying related risks and opportunities
Author/editor: Willem Ligtvoet, Rijk van Oostenbrugge, Joost Knoop, Hanneke Muilwijk and Marijke Vonk
Publisher: Netherlands Environmental Assessment Agency
Download: n.d.
Publication year: 2015
ISBN code: n.d.

This publication is realized by Netherlands Environmental Assessment Agency, the national institute for strategic policy analysis in the fields of the environment, nature and spatial planning. It contributes to improving the quality of political and administrative decision-making, by conducting outlook studies, analysis and evaluations in which an integrated approach is considered paramount. Policy relevance is the prime concern in all our studies. The climate is changing worldwide, therefore also in the Netherlands. Temperatures are going up, it is getting in dryer and heatwaves are occurring more frequently, while precipitation events are becoming more extreme and more intense.

The Dutch Government, with its new Delta Programme, has made an important step forward towards national climate-resilience. However, the programme's adaptation strategy does not cover all the risks and opportunities for the Netherlands in relation to climate change. The Dutch Cabinet plans to have a national adaptation strategy in place by 2016. One of the main element of this strategy is the report containing all the available knowledge on climate change effects, providing the foundation for adaptation strategy. Instead, it focuses mainly on flood protection, freshwater supply, and spatial adaptation to urban flooding and urban heat stress. In addition, the climate is not the only thing that changes; society is also changing and this has various consequences for the Netherlands' vulnerability to climate change. For example, both ageing and the increasing population density within cities will result in greater vulnerability to heat stress and infectious diseases. In the Delta Programme, the main points of urgency for adaptation to climate change concern investments in critical infrastructure and networks, i.e. the power grid and ICT and transport, and in spatial development. This is related to the social importance and the long lifespan and lifecycle of these infrastructures and the related low flexibility for adjusting them to climate change. Therefore, the choices and investments that will be made over the coming years, in part, determine the degree of climate resilience of the infrastructure and networks in the longer term.

Looking at the most urgent climate risks reveals that provinces, municipalities and water boards also have the task of seriously addressing climate resilience in their spatial planning. In recent years, the national government has made considerable investment in knowledge development. Now it is time to utilise this knowledge in projects of implementation on regional and local scales. Climate change adaptation currently is not always incorporated in policy agendas and development projects. And yet they do offer opportunities for affordable climate adaptation. Such opportunities arise in the preliminary process of development, during regular maintenance work, when critical infrastructure needs to be replaced, and when investments are made in urban housing development and redevelopment. Opportunities that are missed will take dozens of years to present themselves again, on all levels: nationally, regionally and locally. The transition towards becoming a more climate-resilient country is no easy feat for the Netherlands; the effects of climate change are still uncertain, the risks and opportunities very divers and such transition requires input from many different parties. The different nature of the adaptation task also means that it is too early to present a fully detailed description of what should be the National Adaptation Strategy. What can be presented, however, are a number of anchors for such a strategy; thus, providing a framework for an effective approach.

Title: US Housing and urban development climate change adaptation plan
Author/editor: Department of Housing and Urban Development
Publisher: USA
Download: n.d.
Publication year: 2014
ISBN code: n.d.

Dealing with climate-related impacts is part of activities of the Department of Housing and Urban Development's to create strong, sustainable, inclusive communities, and quality affordable homes for all Americans. The Department is committed to identifying threats and adapting policies and investments to help communities to better prepare for and respond to the effects of climate change, including rebuilding after natural disasters. Since 2006, the US Congress has appropriated more than $40 billion to Department of Housing and Urban Development's. The Department reinvest these funds in housing, economic development, and infrastructure in ways that prevent damage from future disasters, consistent with the National Disaster Recovery Framework. This Climate Change Adaptation Plan outlines a set of actions designed to address some of the risk posed by climate change to the Department's mission, programs, and operations. In order to develop these actions, the Department participated in an adaptation planning exercise that began with an identification of climate-related risk and vulnerabilities. The staff of Department was engaged to identify risks and vulnerabilities to their mission, programs, and operations. Then, they developed a set of proposed actions to address those risks and vulnerabilities. Each of the actions were vetted by the Resilience Council principals and incorporated into this plan. Afterwards the approval, the Resilience Council will continue to track the implementation of this plan, as well as focus on the following three core activities:

- 1. Create a structure and process to educate the Department's program managers on the evolving risks and vulnerabilities created by a changing climate and make key decisions regarding resilience;
- 2. Engage partners to access the latest climate risk information and build on their work to respond to and anticipate climate impacts and build community resilience;
- 3. Facilitate the completion of key deliverables for Department's resilience work.

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03

EXTREME WEATHER EVENTS CAUSED BY CLIMATE CHANGE

REVIEW PAGES: LAWS

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ADDRESSING CLIMATE CHANGE: FROM THE SENDAI FRAMEWORK TO THE PARIS AGREEMENT

During the XXI Conference of Parties (COP 21) held in December 2015 in Paris, 195 Member States of the United Nations adopted the Paris Agreement, e.g. an ambitious deal to address climate change, which "represents an urgent and potentially irreversible threat to human society and the planet and thus requires the widest possible cooperation by all countries, and their participation in an effective and appropriate international response, with a view to accelerating the reduction of global greenhouse gas emissions" (UN, 2015a). The agreement will enter into force in 2020 if at least 55 Parties to the Convention accounting for at least 55% of the total GHG have signed it. The key element of the Paris Agreement is included in the first part of Article 2, which says that Governments agree to "hold the increase in the global average temperature well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change". Furthermore, the agreement strengths the importance of adaptation measures for decreasing vulnerability to climate change (Article 7) and it stresses the importance of reducing loss and damage associated with the negative impacts of climate change (Article 8). In order to monitor States' progress in the implementation of their emission targets, the agreement establishes that "each Party shall regularly produce a national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases" (Article 13).

As for every important deal on climate change, some analysts and environmentalists are skepticism about it and consider it a weak agreement. The main critic is that choosing 2023 for the first review of emissions reductions could be too late for achieving the determined emission targets if countries continue polluting as they have been doing by now. Despite the predictable critics, the ambitious agreement represents a historic success for the global society, and it is the result of years of intense negotiations amongst all members of the United Nations started six years ago with the Copenhagen climate summit and continued with the adoption of the Sendai Framework for Disaster Risk Reduction in March 2015, of the Addis Ababa Agenda in July 2015 and, finally, of the resolution "Transforming our world: the 2030 Agenda for Sustainable Development" in September 2015. In this issue of TeMA these three agreements are described in order to provide a useful framework for a better understanding of the Paris Agreement on climate change.

2030 AGENDA
FOR SUSTAINABLE DEVELOPMENT

In September 2015 the United Nations presented the 2030 Agenda for Sustainable Development, announcing 17 new global Sustainable Development Goals (SDG) with 169 associated targets; eradicating poverty and achieving gender equality are the main priorities. This is a list of the new 17 SDG that will came into effect in January 2016 and should be considered by Member States as guideline principles for their development in the next 15 years (UN, 2015b):

- end poverty in all its forms everywhere;
- end hunger, achieve food security and improved nutrition and promote sustainable agriculture;
- ensure healthy lives and promote well-being for all at all ages;
- ensure inclusive and equitable quality education and promote lifelong learning opportunities for all;
- achieve gender equality and empower all women and girls;
- ensure availability and sustainable management of water and sanitation for all;
- ensure access to affordable, reliable, sustainable and modern energy for all;
- promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all;
- build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
- reduce inequality within and among countries;
- make cities and human settlements inclusive, safe, resilient and sustainable;
- ensure sustainable consumption and production patterns;
- take urgent action to combat climate change and its impacts;
- conserve and sustainably use the oceans, seas and marine resources for sustainable development;
- protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss;
- promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels;
- strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

The new Agenda highlights the importance of global partnership to ensure the effective achievement of the goals and, in particular, in continuity with the Addis Ababa Action Agenda, it introduces the Technology Facilitation Mechanism to promote the collaboration between States and support developing countries. The Mechanism will include three main elements: (1) a United Nations inter-agency task team on science, technology and innovation for the SDG; (2) a multi-stakeholder forum on science, technology and innovation for the SDG that will meet once a year to promote the spread of knowledge in different thematic areas; (3) an online platform to support the dissemination of information, experiences and best practices. Furthermore, another important aspect covered by the Agenda is that of *Follow-up and review* the progress achieved in the next 15 years. In order to facilitate the process at the national, regional and global level, the United Nations have just agreed a set of 230 global indicators developed by the Inter-Agency and Expert Group on SDG indicators that will constitute a unified framework for monitoring and measuring the implementation of the 2030 Agenda around the world.

ADDIS ABABA ACTION AGENDA – FINANCING FOR DEVELOPMENT

The Addis Ababa Action Agenda (AAAA) has been adopted in July 2015 by the 193 UN Member States that attended the United Nations Third International Conference on Financing for Development. AAAA's goal was to provide a holistic framework for implementing the global sustainable development agenda that world leaders adopted few months later, in September 2016, and which has been previously described.

The AAAA identifies a set of over 100 policy actions to financially support sustainable development and reach the SDG. Moreover, it provides a new global financing framework that aligns financial flows with public goals to achieve sustainable development in its three dimensions through promoting inclusive economic growth, protecting the environment, and promoting social equity (UN, 2015c). The concrete policy measures contained in the AAAA are structured into 7 *action areas*:

- domestic public resources: they are crucial for achieving sustainable development and States are called to improve the fairness, transparency and efficiency of their tax systems and reduce illicit financial flows by 2030 (UN, 2015c);
- domestic and international private business and finance: they play a fundamental role to the pursuit of sustainable development. The Agenda includes a number of actions that support access to finance for micro, small and medium sized enterprises and it establishes that the average costs of transmitting remittances across borders have to be reduced to below 3% by 2030;
- international development cooperation: developed countries are encouraged to support least developed countries providing them at least 0.2% of official development assistance by 2030;
- international trade as an engine for development: the Agenda highlights the positive results in multilateral trade negotiations achieved by the World Trade Organization (WTO) and it invites WTO members to increase their commitments;
- debt sustainability: the AAAA recognizes that developing countries need support in attaining debt sustainability and it calls for coordinated policies aimed at fostering debt financing, debt relief, debt restructuring and sound debt management (UN, 2015c);
- addressing systemic issues: the Agenda underlines the important role of the United Nations in promoting sustainable development and it highlights that financial stability represents one of the main elements to avoid volatility. Moreover, the AAAA invites States to give bigger space to developing countries in international law decisions;
- science, technology, innovation and capacity building: all of them are considered strategic for the implementation of the SDG and it is the AAAA that establishes for the first time the Technology Facilitation Mechanism previously described;
- data, monitoring and follow-up: the Agenda recognizes the importance of monitoring the implementation of the agreed measures and it introduces the Financing for Development Forum to be held once a year in order to present each State's progress in achieving the SDG. Furthermore, the AAAA invites the United Nation system to construct new indicators to measure progress because per capita income cannot be considered a reliable measurement anymore; the 230 global indicators approved at the beginning of March represent a practical good starting point.

In conclusion, the AAAA aims at addressing "the challenge of financing and creating an enabling environment at all level for sustainable development in the spirit of global partnership" (UN, 2015c).

SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION

The Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted in March 2015 during the Third United Nations World Conference on Disaster Risk Reduction. The agreement follows the Hyogo Framework for Action (HFA) 2005-2015 and, in continuity with it, its goal is to "prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience" (UNISDR, 2015). The instrument is voluntary and it is not binding. Following the HFA, the Sendai Framework promotes a new approach more oriented towards disaster risk management rather than towards disaster management, and it considers primary responsibility of central Governments to prevent and reduce disaster risk but, at the same time, it encourages cooperation between national bodies and different stakeholders. The agreement identifies four priorities of action that States have to take into consideration in their strategy for achieving the Framework's outcomes (UNISDR, 2015): (1) understanding disaster risk; (2) strengthening disaster risk governance to manage disaster risk; (3) investing in disaster risk reduction for resilience; (4) enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction. Together with these four priorities, the Sendai Framework also identifies seven global targets to be reached at national level by the different States that participate to the agreement: reduce global disaster mortality by 2030; reduce the number of affected people globally by 2030; reduce direct disaster economic loss in relation to global gross domestic product by 2030; reduce disaster damage to critical infrastructure and disruption of basic services by 2030; increase the number of countries with national and local disaster risk reduction strategies by 2020; enhance international cooperation to developing countries; increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030. In the end, this Framework provides States a set of directions to guide their action to prevent and reduce disaster risk as well as a number of specific targets to be achieved.

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04

EXTREME WEATHER EVENTS CAUSED BY CLIMATE CHANGE

REVIEW PAGES: URBAN PRACTICES

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ADDRESSING VULNERABILITY OF URBAN INFRASTRUCTURES TO CLIMATE CHANGE: TWO CASE STUDIES

According to the United Nations (UNFCCC, 1992), the climate change can be defined as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere". While debates, so noted in the mainstream media, persist about whether or not climate change is due to anthropogenic causes (Hoffman, 2011), it is clear that new weather and climate patterns are emerging and that these changes are putting urban areas at risk (World Bank, 2010). Some cities have already seen changes in rainfall, resulting in more floods. Others have experienced changes in temperatures that have contributed to extended heat waves and droughts. Still others have encountered storm surges, coastal erosion, and the disappearance of wetlands (U.N.-Habitat, 2011). As these and other changes become more pronounced in the coming decades, they will likely present challenges to our urban environment (Salat and Bourdic, 2012).

Urban infrastructure lies at the heart of modern societies, representing an essential component of the contemporary cities. Buildings, water and waste systems provide the basic services that households and businesses require, while transportation and communications infrastructures enable people to participate in various activities, such as employment and learning opportunities, and to make use of local services, such as healthcare, food shops, and recreational facilities. Clean, efficient and well-maintained infrastructure supports a high quality of life in developed countries while the provision of such infrastructures in developing countries is critical to raising living standards in the context of future development (Kennedy and Corfee-Morlot, 2013).

As climate change may significantly affects the operational, financial, environmental and social performance of such infrastructures (Kennedy and Corfee-Morlot, 2013), it has become increasing important to entails constructing or renovating infrastructure systems in order to make these systems, and the societies they serve, more adaptable to extreme weather conditions and rising sea levels. Cities worldwide are increasingly recognizing the need to prepare their infrastructures for the impacts of climate change and, in the last decade, some have introduced new planning tools to ensure long-term, cost-effective adaptation measures. These measures are generally part of broader adaptation strategies aimed to facilitate the adjustment of human settlements to altered climate regimes. In this section, two relevant case studies are illustrated:

- The New York City's Department Of Environmental Protection' Climate Change Adaptation Programme

- The Transport For London's Climate Change Adaptation Programme.

NEW YORK CITY'S DEPARTMENT OF ENVIRONMENTAL PROTECTION' CLIMATE CHANGE ADAPTATION PROGRAMME

With over 8.5 million inhabitants, New York City (NYC) is the most populous city in the United States and one of the most populous urban agglomerations in the world. The city has responded to a variety of significant environmental challenges in its history, and the latest one, which requires long-term strategic planning, is climate change, which is projected to have wide impacts on its critical infrastructures and population through higher temperatures, more intense flooding events, and sea level rise. According to a recent report (Horton et al., 2015), the impacts of climate change will be pervasive and profound in NYC. Most natural and man-made systems will be affected, and the City's water supply, drainage, and wastewater management systems are no exception. NYC's surface water is supplied from a network of 19 reservoirs and 3 aqueducts, providing approximately 1 billion gallons of safe drinking water daily. The City is served by one of the largest wastewater collection and treatment systems in the world, with 14 wastewater treatment plants and 96 pumping stations over 1.3 billion gallons of wastewater per day, using state-of-the-art technology.

To overcome the challenges of climate change, as stewards of the City's water systems, the New York City Department of Environmental Protection (DEP) is placing its response to climate change at the core of its strategic and capital planning. In essence, the Department's plan is to adapt the City's water systems to withstand climate changes and upstate watershed while simultaneously striving to help minimize those changes. The Adaptation Programme is the result of an ongoing decision-making process, started in 2004, when the DEP established partnerships with a range of scientists and engineers and created a formal Climate Change Task Force to oversee the Department's investigation of and preparation for the potential risks associated with climate change. The process continued in 2008 when the DEP published the Climate Change P Climate Program Assessment and Action Plan (NYC-DEP, 2008) including finding, recommendations and immediate action that the DEP is committed to undertaking in the near future to further address climate-related critical issues. The process continued in 2013 with a second report presenting a comprehensive assessment of wastewater facilities at-risk from future storms, potential costs, and suggesting measures to protect critical equipment and reduce the risk of damage and loss of services (NYC-DEP, 20113). The DEP Task Force identifies the main threats to the water supply system, including potential water quality and demand changes over time due to changes in the ecology of watershed and changing temperature. With respect to the wastewater and drainage the main threats come from more extreme storm surge events and continued sea level rise, resulting in high flooding risk in the future. Building on vulnerability study, the DEP sets forth cost-effective strategies for reducing flooding damage to wastewater infrastructure and safeguarding public health and the environment. In determining the benefits of resiliency measures and the level of acceptable costs, DEP considered not only the value of wastewater assets, but also the population and critical facilities in the service areas and potential impacts on beaches. Resiliency measures were then selected based upon costs and level of risk reduction. The result is a portfolio of strategies that will be "shovel ready" for funding opportunities and implementation as part of planned capital projects. Actions to make the wastewater transport system more resilient include the construction of static barriers around selected location, sealing structures with watertight windows and doors, sandbagging temporarily, the development of resiliency projects at the 58 pumping stations that are vulnerable to storm surge damage.

TRANSPORT FOR LONDON'S CLIMATE CHANGE ADAPTATION PROGRAMME

With over 7.3 million inhabitants, London is the capital and most populous city of England and the United Kingdom. Its position as a dynamic world city clearly depends significantly upon its transport system with 26 million trips made each day for work, education or leisure.

Extreme weather in recent years has brought challenges to keeping London moving – flooding, heat waves and storms have all brought about delays and increased costs that have affected London's economy and the well-being of Londoners. According to a recent report (CCCA,2010), predicted climate change will increase the frequency and intensity of extreme weather on top of a general trend towards hotter, drier summers and warmer, wetter winters. In particular, predictions suggest that the London's transport systems will need to operate through warmer, wetter winters and hotter, drier summers, with increased incidences of storms and flooding. Transport for London (TfL), the local government body responsible for most aspects of the transport system in Greater London, has assessed and evaluated the future climate impacts on its assets and services, referencing the latest generation of climate projections, the 2009 United Kingdom Climate Projections. There are a number of elements of London's transport network that have the potential to be affected by weather related events, such as flooding, overheating, low temperatures and snow. As a transport provider it has a responsibility to operate a network that is as low-carbon as possible and resilient to the expected changes in the city's climate. TfL supports the delivery of the Mayor of London's strategy commitment of a 60% reduction in the Capital's CO2 emissions by 2025, against 1990 levels. By then, the city's total number of residents is expected to have increased by one million and it is vital that TfL delivers the services London needs to support this growth while minimising its emissions and any resulting damage to the local environment. TfL is working to tackle climate change by changing the way people travel: encouraging people to operate their vehicles more efficiently; investing in lower carbon fuels and technology; and by looking at the way it manages its business activities. TfL is already taking steps to mitigate and adapt to the impacts of climate change through programmes/initiatives such as 'Cooling the Tube', and risk analysis work as detailed in the Providing Transport Services Resilient to Extreme Weather and Climate Change report (TfL, 2009). In this work TfL has assessed and evaluated and identifies three major transport risks from flooding. Within the underground system, stations, tracks, trains, depots and supporting infrastructure would be affected, causing delays and suspension of services. For surface transport, flooding of highways and greenway networks, including underpasses, subways and tunnels could cause diversions and delays. Regarding river transport, waterborne freight and the Woolwich ferry may be at risk due to closure of the Thames Barrier. Transport for London is preparing strategies addressing the climate resilience of the London transport network under a range of climate risks. With regard to London Underground, the current programme for upgrading lines and increasing capacity has prompted interventions to counteract temperature increases that will also address overheating due to climate change. These interventions include increasing air-conditioned carriages and chiller units on stations, as well as improving ventilation and raising passenger awareness. Air conditioning on mainline trains, currently at about 50% will also increase as stock is replaced. New buses are built to better heat - resilient standards while the existing fleet is being retrofitted with cooling systems. However, most of London's transport is dependent upon electricity or diesel and the Strategy urges TfL to consider the resilience of its energy supply under extreme climate conditions. Implementation of measures to reduce flood risk, including source control (e.g. green roofs, pervious pavements), flood storage, have been planned. They include the construction of higher capacity drains, better drain maintenance, flood warning, and barriers to prevent water ingress to stations, and better information on flooding to transport users. Monitor temperatures and humidity in the Underground, both in trains and at stations is another important component of the TfL strategy.

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05

EXTREME WEATHER EVENTS CAUSED
BY CLIMATE CHANGE

REVIEW PAGES: NEWS AND EVENTS

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DYNAMIC FRAMEWORK APPROACH FOR CLIMATE CHANGE

Significant changes in climate and their impacts are already visible globally, and are expected to become more pronounced in the next decades. it is widely accepted that our planet will face the impacts of climate change even if the greenhouse gas emissions will be significantly reduced in the coming decades through the implementation of mitigation policies worldwide. In this context, urban areas are the most likely to pay the higher social costs of global warming and, for this reason, is becoming increasingly urgent to adopt adaptation strategies at local scale to deal with the climate change effects. Due to the complexity of the urban system, climate change adaption and mitigation strategies require a vision able to hold together the different political choices in a dynamic framework of analysis and scenarios, to be introduced in the territorial planning and building transformations, in order to change the forms and uses of space in both the city structure and architecture (De Gregorio Hurtado, 2015); the concept of adaptation doesn't means just protection against the weather extremes, but also a greater flexibility of the cities for change by taking advantage of its possible benefits. In order to guarantee the protection of citizens, infrastructure, services and residences from the impacts of catastrophic events these strategies have to deal with a number of challenges which should be addressed to make progress on climate change adaptation. These include:

- improving the climate models and scenarios at urban and regional level, to reduce the vulnerability of the settlements;
- advancing understanding on 'good practice' in adaptation measures through exchange and information sharing on feasibility, costs and benefits in order to promote sustainable politics both economic and environmental;
- promoting low carbon policies in order to reduce the Co2 emissions;
- involving the public and private sector, and the general public at both local and national level.

In this scenario the whole society should be involved. The collaboration among all the stakeholders (policy makers, NGOs, companies, citizens) is essential to create a sense of responsibility on climate adaptation policies, helping to increase the coherence in the adaptation action and developing a capacity for adaptation in the society as a whole; the implementation of new communication technologies is an useful tool to develop a more participated decision-making process.The following conferences could represent a fertile soil for the birth of a new awareness on this issue by comparing the different international experiences and studies.

ADAPTION FUTURE - 4TH INTERNATIONAL CLIMATE CHANGE ADAPTION CONFERENCE

Where: Rotterdam - Nederland
When: 10 - 13 May 2016
http://www.adaptationfutures2016.org/

The conference offers a platform to exchange new and practical ideas, experiences and insights for climate change adaptation promoting solutions across sectors, borders and communities.

Participants are asked to demonstrate how their findings might be applicable to other communities, countries or sectors. The conference is structured in three kind of sessions: science sessions, practice sessions and combined science-practice sessions. For the latter, companies and public authorities are invited to contribute to scientific research, showing the results of their practical experiences, relevant for the conference topic. The main themes are the following:

Cities and infrastructure food; forestry and rural livelihoods; fresh water availability and access Public health; ecosystems and ecosystem based adaptation; disaster risk reduction; the Arctic Seven; Around these themes there are three cross-cutting issues as guideline for the session proposals:

- Risk assessment, adaptation planning and evaluation;
- institutions and governance;
- finance, investment and business.

The issue of poverty and inequality is a recurring topic under all seven themes and three cross-cutting issues: because the poorer communities are typically the most vulnerable, adaptation policies can help curb poverty and avoid magnifying existing inequality if their impacts on social development -for instance access to public goods and gender inequality- are considered.

The conference will prioritize contributions that demonstrate the added value of combining knowledge, experience and innovation across themes and issues.

CLIMATE ADAPTION 2016- CHANGE, CHALLENGE OPPORTUNITY

Where: Adelaide – United States
When: 5-7 july 2016
http://climate-adaptation.org.au/

The main topic of the conference is Change, challenge and opportunity; the purpose is to promote research and experiences that go beyond the simple ability of cities to limit damage of increasingly frequent catastrophic events, by transforming risk into opportunity.

The main goal is to create new awareness in order to implement policies able to change the current urban structure towards a more sustainable society. Representatives from public and private sectors, federal, state and local governments, researchers, practitioners, consultants, NGOs, students, are invited to share and network innovative proposals and to promote adaptive politics.

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ICUR 2016 - INTERNATIONAL CONFERENCE ON URBAN RISK

Where: Lisbon – Portugal
When: 30 June - 2 July 2016
http://www.ceru-europa.pt/icur2016/

Given the significant impact that natural hazards and climate change will have on urban investments, increasing priority is now placed on adaptive planning to reduce and manage the potential for disasters and climate change; for this reason a lot of cities are experiencing methods and tools to embed risk reduction and awareness into the design of urban spaces to increase the resilience of local communities.

This conference offers a platform of discussion on this topic, addressing concepts and methods on risk management, and the assessment of a variety of risks, such as risks induced by natural hazards, environmental and health risk and societal risks;

The main goal of the conference is to share experiences and original research contributions for the reduction of the impact of natural and technological hazards on urban societies.

6TH INTERNATIONAL CONFERENCE ON BUILDING RESILIENCE

Where: Auckland – New Zealand
When: 7-9 September 2016
http://buildresilience2016.nz/

Planning for urban resilience, and specifically adaptation, is well under way in a number of cities around the world. The Building Resilience Conference is an annual meeting on this topic, now in its sixth edition; the aim of the conference is to explore the risk-based approaches used into urban governance and planning processes to help national and municipal stakeholders to make complex decisions in a more forward-looking and more sustainable way.

Resilience appears as new paradigm for urbanization and influences the way to manage urban hazards, as well as urban planning in general, incorporating the management of disasters and climate risks into urban investments. Key economic sectors —especially water, energy, and transport systems—deserve particular attention.

They are not only vital if cities and communities are to deal with a disaster and recover quickly, they are also sectors where careful investments can make a real difference in people's lives.

The Conference series brings together researchers and industry practitioners involved in natural hazards and disaster resilience across the globe, providing participants with a strong platform for knowledge sharing, collaboration, disciplinary reflections, institutional exchange and collective growth.

INPUT 2016 - 9TH INTERNATIONAL CONFERENCE ON INNOVATION IN URBAN AND REGIONAL PLANNING

Where: Turin – Italy

When: 14-15 September 2016

http://www.input2016.it/conference_2016

The main topic of the conference is "e-agorà for the transition towards resilient communities". It start from the assumption that the concept of resilience represents a dynamic element, subject to the changing circumstances in which the person plays an active and not given role (Rutter, 1985). Therefore, a community can be defined as resilient if the individuals who compose it represent an active part of the dynamic transformation of the city. According to the Smart City paradigm, the use of ICT in the planning process can represent an effective tool to generate a continuous dialogue between citizens, improving their awareness and resilient attitude to the unavoidable changes that cities are facing. This Ninth Edition of the conference aims at rising a debate on the Innovation and the use of ICT in planning, management and evaluation issues defining methods and techniques to improve the process of knowledge acquisition. The necessary multidisciplinary approach to deal with these issues calls into question not only technical or systemic methodologies, but also societal and ethical aspects, assigning a new kind of responsibility to the needed research and innovation efforts.

The main topics of the conference are the following:

- Sharing responsibilities;
- (e-qual)ity living;
- environment and land use;
- transition and innovation theories;
- maintenance, upgrading and innovation in cultural heritage;
- new economies;
- big data and data mining;
- ict & models: planning for communities.

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IMAGE SOURCES

The image shown in the first page is taken from:
https://www.eda.admin.ch/content/dam/deza/en/documents/publikationen/Wirkungsberichte/234508-wirkungsbericht-2014-klimawandel_noorder_EN.pdf

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