

Chapter 25

Understanding the Role of Urban Morphology and Green Areas Configuration During Heat Waves

Marialuce Stanganelli

University of Naples Federico II, Italy

Carlo Gerundo

University of Naples Federico II, Italy

ABSTRACT

This paper focuses on urban planning strategies to adapt cities to the increasing rising of temperatures during summer heat waves. The main target is to investigate which configuration and distribution pattern of green spaces could effectively improve natural cooling of urban environments. Although the benefit that green areas give to natural cooling is well known, this kind of studies has hardly been carried out, especially at an urban scale where it is crucial to define quantities and density of green areas to address open spaces design. To reach this goal, a methodology based on the interpretation of the statistical correlation among temperature, urban parameters and green areas configurational indicators was implemented and applied to the case study of the Municipality of Naples, performing all the analysis in a GIS. Results provide guidelines to improve natural cooling in urban areas adopting the most effective configuration and distribution of green areas within a densely-built context.

INTRODUCTION

Presently, climate change adaptation in urban areas is more urgent than ever since more than half of the world population lives in urban areas and this rate is expected to be 75% by 2050. Among the risks of climate change, heat waves are considered one of the most severe on cities liveability because they can worsen the Urban Heat Island phenomenon (UHI). According to the Fifth Report of the Intergovern-

DOI: 10.4018/978-1-5225-9276-1.ch025

mental Panel on Climate Change (IPCC, 2013) heat waves are expected to grow in number and intensity in Europe, especially in Southern Europe Cities.

This phenomenon is extremely dangerous for human health: data on the number of deaths due to the European heat wave of 2003 (about 35000) make it one of the more devastating natural disasters of last decade (EM DAT). Projections suggest that 1-in-20-year hottest day is likely to become a 1-in-2-year event by the end of the 21st century in most regions (IPCC, 2013). In big cities, heat waves further increase their intensity and dangerousness because of the phenomenon of Urban Heat Island (UHI). UHI is a thermal anomaly affecting large urban settlements where temperatures are higher than surrounding rural areas. The intensity of this phenomenon can be quantified as the maximum difference between the average temperature of urban air and the one of surrounding rural environment. The difference appears to be more pronounced at night than during the day. For instance, during summer periods the temperature difference between urban and suburban areas can range from +1 °C to +3 °C in daylight, while at night it can reach values ranging from +7° to +12° C (Bonafè, 2006).

The high vulnerability of Metropolitan areas to heat waves effect is due to the widespread overbuilding, the prevalence of paved surfaces on green areas, the use of building materials with low ability to dissipate heat, the morphology of some urban tissues which obstruct natural ventilation, the huge amount of emissions caused by human activities (traffic, industrial plants, heating and air conditioning systems for household use).

Air conditioning could be no more considered the only solution to urban high temperatures and other mechanism of passive and natural cooling must be developed to reduce its use.

Air conditioning and other forms of mechanical cooling contribute to Greenhouse gases emissions (CO₂ mostly), increasing energy consumption. During heat waves, UHI can produce peak demands for energy consumption with consequent power blackouts in metropolitan areas (Zauli Sajani et al., 2008). Some scholars estimated that every degree increase (K) adds a significant supply to the air conditioning load evaluated between 5% and 10% of total consumption (Akbari et al., 2009).

Moreover, high temperatures intensify photochemical reactions of pollutants in the air: for every degree of temperature over 22°C, accident by smog increases by 5% (Di Cristo et al., 2009). Urban planning could play a crucial role in developing urban resilience to CC effects and contribute to adaptive efforts but often urban planning have been used in a traditional way without considering that a new challenge needs new tool and new strategies.

A rethinking of urban planning and a reassessment of the discipline itself is necessary. Planners and researchers should focus their efforts on the development of new tools to improve cities climatic performances and new ways to use Ecosystem services as active urban 'structural materials' (ESPACE, 2008; Matthews, 2011).

Water, sun, wind and green could be used in strategic ways to redefine urban spaces and increase urban adaptation to heat waves. Therefore, urban design should be more related to site, climate and nature and urban planning should be provided of techniques and tools to analyze, understand and manage microclimatic conditions

With regard to adaptation to extreme heat events, many examples of environmental stewardship can be found in high-income countries. In locations with large daily variations in temperature, an incisive response can include upgrading homes with passive cooling system in order to reduce solar and internal heat gains, while enhancing natural ventilation or improving insulation (Holmes & Hacker, 2007; Roberts, 2008). Usually interventions to promote natural cooling do not go beyond architectural scale.

14 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/understanding-the-role-of-urban-morphology-and-green-areas-configuration-during-heat-waves/231322

Related Content

There's an App for That: Mobile Applications for Urban Planning

Jennifer Evans-Cowley (2012). *International Journal of E-Planning Research* (pp. 79-87).

www.irma-international.org/article/there-app-mobile-applications-urban/66413

Making Citizens' Activities Flourish Through a Crowdsourcing-Based Social Infrastructure

Mizuki Sakamoto and Tatsuo Nakajima (2019). *Smart Cities and Smart Spaces: Concepts, Methodologies, Tools, and Applications* (pp. 1535-1560).

www.irma-international.org/chapter/making-citizens-activities-flourish-through-a-crowdsourcing-based-social-infrastructure/211355

Participatory Mapping and PGIS: Secerning Facts and Values, Representation and Representativity

Michael K. McCall (2021). *International Journal of E-Planning Research* (pp. 105-123).

www.irma-international.org/article/participatory-mapping-and-pgis/269470

Multi-Agent Systems for Urban Planning

Andrew T. Crooks, Amit Patel and Sarah Wise (2014). *Technologies for Urban and Spatial Planning: Virtual Cities and Territories* (pp. 29-56).

www.irma-international.org/chapter/multi-agent-systems-for-urban-planning/104210

System Approach to MIS and DSS and its Modeling within SD

Miroljub Kljajic, Mirjana Kljajic Borštnar, Andrej Škraba and Davorin Kofjac (2012). *Regional Development: Concepts, Methodologies, Tools, and Applications* (pp. 315-335).

www.irma-international.org/chapter/system-approach-mis-dss-its/66124