# MEGACITIES 2050: From Urbanization Risks Towards Sustainable Urban Development

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**Abstract.** Urbanization is a long-term global trend, responsible for substantial environmental changes. At the same time, urban ecosystems are vulnerable and their adaptation to the ever-changing environment is necessary to sustain essential functionality and important ecosystem services. Sustainable urban development demands the integration of innovative green technologies and nature-based solutions in urban management, which is only possible through a collaboration and participation of all stakeholders including scientists, landscape designers, civil engineers, policy makers, and all citizens.

**Keywords:** Urban ecosystems · Megapolis · Monitoring · Environmental management · Green infrastructure · Urban soils · Ecosystem services

Globally, urban areas grow rapidly with more than two thirds of the world population expected to live in cities by 2050 [1, 11]. Urbanization influences the environment and may contribute to e.g., climate change, soil degradation and biodiversity reduction. At the same time, urban ecosystems are very sensitive to global changes, and their adaptation is necessary to sustain essential functionality and important ecosystem services [5].

Historically, urbanization was mainly studied as a potential environmental threat, resulting in soil, water, atmospheric and forest degradation and biodiversity loss. The unfavorable ecological state of urban environments was documented by the beginning of the 21st century [3, 8]. An established urban ecosystem strongly differs from a natural or agricultural ecosystem. Urban ecosystems are characterized by the human modified and often artificial landscapes with considerable anthropogenic disturbances (e.g., environmental pollution, soil sealing, waste disposal). Cities generally consume much more energy than they generally provide, resulting in the emissions of heat, (airborne and waterborne) contaminants and greenhouse gases. With the continued increase of global urban population, novel concepts like 'sustainable cities' have emerged. The concept of urban sustainability resulted in the design of model or ideal cities, for example, 'emission free' cities [6] and 'climate adapted' cities [7] which view

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urban areas as source of unique natural and urban-specific resources, rather than an environmental threat.

The international conference Megacities 2050 aimed to find solutions for environmental problems of modern megapolises and to maximize the capacity of urban ecosystems to support specific ('natural') functions and services. The conference proceedings introduce urban ecosystems, considering their spatial variability, temporal dynamics, environmental risks and potentials to provide important functions and ecosystem services. The volume includes 18 papers, describing different components of urban ecosystems (e.g., air, soil, vegetation and biota) and covering different aspects of environmental monitoring, assessment and management in megacities.

The general concept of megacities as diverse and complex ecosystems is presented in the first paper "Urbanization of Bioshphere: from Mega- to Ecopolises". The subsequent papers are organized into four different thematic sections: (i) air quality and greenhouse gases (GHGs) emission (papers 2 and 3), (ii) urban soils at multiple-scales (papers 4 to 9); (iii) urban forests and green infrastructure (papers 10 to 13); and (iv) advanced technologies in monitoring, modeling, designing and management of urban ecosystems (papers 14 to 18).

Maintaining air quality, carbon sequestration and mitigating global warming and climate changes by reduced GHGs emissions are key servives provided by urban ecosystems. The supply of these services for the cases of Naples (Italy) and Moscow (Russia) is discussed by the papers in Section 1. Urban soils are key for regulating healthy urban ecosystems. Ecosystem services and functions provided by urban soils impact the environment, and human health and wellbeing [4]. Urban soils that form conditions and features differ principally from natural and agricultural soils, but their functions and services remain poorly quantified [9]. Recently, there has been increased attention and interest in understanding the capacity of urban soils to support specific functions and services [5, 7, 10]. Currently, urban soils face a paradox where on one hand it is of the highest value for property development, and on the other hand being almost totally ignored with regard to the ecosystem servies they can provide [4]. Different aspects of monitoring and assessment of urban soils at multiple scales from local and city level (Rostov in Russia and New York in USA) to regional and global scales are discussed in Section 2. Similar problems (e.g., contamination with heavy metals) were presented for urban soils located at different climates and vegetation zones (e.g., Yamal in arctics, Bashkortostan in steppes and New York in the humid continental/temperate), providing a unique opportunity for comparative assessments. Section 3 focuses on green infrastructure as the main tool to integrate nature-based solutions into urban design and management. Finally, Section 4 promotes a range of technologies to monitor and manage urban ecosystems, including biotesting, decision-support systems and ecological engineering.

The conference received feedback from a broad and multi-disciplinary audience, including the scientific community, municipal services, the environmental protection agency and other stakeholders working in urban management and greenery. Such a multi-disciplinary discussion is an essential step towards sustainable urban development, because implementation of innovative technologies and nature-based solutions relies on a collaboration of all interested stakeholders for the purpose of smart urban management.

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