Online Pre-Conference

WATER, MEGACITIES AND GLOBAL CHANGE

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Green infrastructure and stormwater management: opportunities and challenges

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Summary Outline

1. Introduction
2. Methods
3. Results

Conclusions

This presentation is based on the authors’ conference paper: Rae Zimmerman, Bernice Rosenzweig, and Alan Cohn, “Green Infrastructure and Stormwater Management: Opportunities and Challenges,” *Proceedings of the Second International Conference* “Water, Megacities and Global Change,” Paris, France: UNESCO, November 2020. https://en.unesco.org/sites/default/files/zimmerman.pdf

1. Introduction

1.1 The problem and context

- Natural hydrologic systems are often modified as cities develop and alter waterways.
- This occurs through the construction "gray" infrastructures for stormwater management with or without sewage flows and wastewater treatment especially during precipitation events.
- Water quality impacts and contributions to multiple types of flooding result.
- Green infrastructure (GI) has been introduced to increase water retention through the use of vegetation and soils and has social and ecological co-benefits also.

1.2 Using megacities as a platform. Case studies of the use of GI in large U.S. cities are presented for Los Angeles, Chicago, and New York.

1.3 An integrative approach. The use of GI is evaluated from an integrated social, ecological, and technological systems (SETS) perspective (National Science Foundation Cooperative Agreement 1444755, Urban Resilience to Extremes Sustainability Research Network).

- The social dimension (S) focuses on finance and institutions.
- The ecological dimension (E) focuses on case study physiographic and climatological settings and early future climate change projections.
- The technological dimension (T) is reflected in the GI technologies and their interface with conventional stormwater infrastructure technologies.

2. Methods

The Chicago, Los Angeles, and New York cases were selected on the basis of the size of their populations and characterization as megacities or emerging megacities. The populations of NY and LA exceed 10 million and Chicago's population is ap

The three case cities also represent different U.S. geographic regions.

The map shows the locations of these three case stu cities against the magnitude of annual precipitatior

Data sources included:

- City information for the management of water quality and flooding with both gray and green infrastructures.
- The American Society of Landscape Architects (ASLA) databases is used particularly for finance (Zimmerman, Brenner and Llopis Abella 2019).

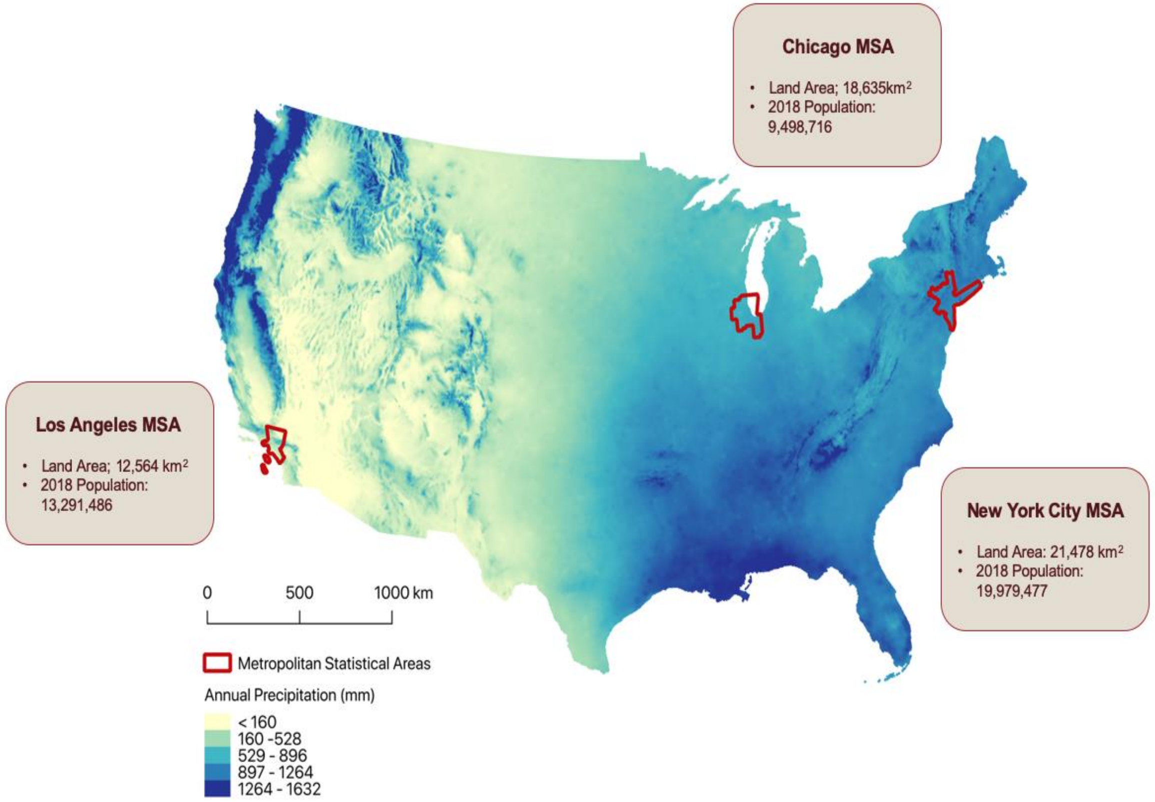

Figure 1: Three US Case Study Cities. Data sources: PRISM Climate Group, 2004, US Census 2019 (from Zimmerman, Rosenzweig and Cohn 2020)

3. Results: MegaCity Case Studies

Most larger cities in the U.S. that experience stormwater problems are regulated under the federal Clean Water Act and are under consent decrees.

Los Angeles, California has experienced large scale flooding of a number of different types and associated sediment loss (Sanders and Grant 2020; Orsi et al. 2004). The City has managed much of it through the use of gray infrastructure (City of Los Angeles 2018). Los Angeles' stormwater is regulated under a Clean Water Act permit and water quality limits are expressed as TMDLs. The City is integrating small and large scale vegetated and unvegetated GI to complement its gray infrastructure systems which is expected to increase costs (City of Los Angeles 2018).

Chicago, Illinois is vulnerable to heavy precipitation, exacerbated by a flat topography and shallow groundwater (Chagnon and Westcott, 2002). It has also historically relied upon gray infrastructures, and it has actually reversed the flow of the Chicago River to be able to manage water quality (Hill, 2019). Like the other case cities, stormwater combined sewer overflows (CSOs) are managed under a Clean Water Act permit, which requires the incorporation of GI (City of Chicago, 2014).

New York City, New York is subject to pluvial flooding from cloudburst episodes (Depietri and McPhearson, 2018; Rosenzweig et al., 2018). Its stormwater has traditionally been managed using an extensive gray infrastructure network (Walsh and LaFleur, 1991). The City has a very active GI planning process and many projects are underway (NYC DEP, 2019). The City's performance metric is illustrated below.

3. Results: GI CSO Mitigation Performance Metric, NYC

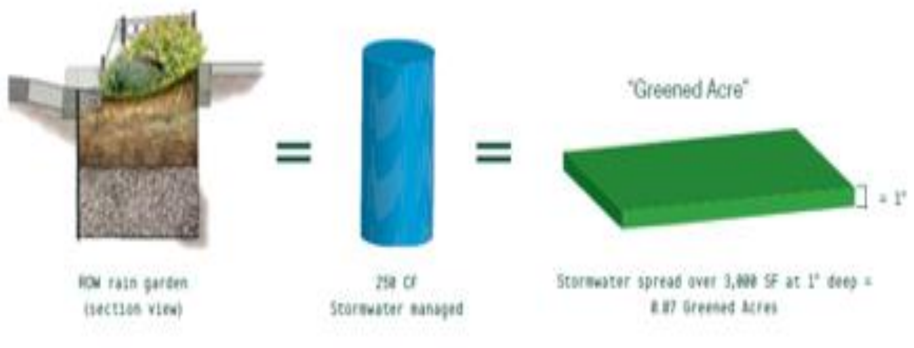

Figure 2: Performance metric approach under the NYC GI Plan (NYC DEP, 2019: 55)
(from Zimmerman, Rosenzweig and Cohn 2020)

3. Results: Application of the SETS Framework

The social aspects of the SETS framework are represented by institutional and financial programs. Institutional programs are regulatory programs under the Clean Water Act through consent decrees as well as GI planning programs within the cities that are also part of the regulatory requirements in some cases. GI finance is still very diverse but tends to rely upon a few major sources of funding (Zimmerman, Brenner and Llopis Abella 2019). The diversity of financial sources reflects the wide range of costs, since different technologies vary in cost.

The ecological aspects reflect the use of different vegetative and soil relationships and alterations in natural landscapes to promote water quality and water retention.

The technological aspects pertain to the interface between GI and gray infrastructures. GI serves as both an ecological and technological approach to water management as well as having social benefits.

Conclusions

GI is a cross-cutting approach to stormwater management with its social, ecological and technological characteristics and benefits. It thus illustrates the SETS concept.

While stormwater GI resources have mostly been centered on Clean Water Act compliance, the opportunity exists for new funding and approaches to GI to maximize flood reduction benefits. This will require changes in modeling and implementation approaches to accommodate a flooding focus. For implementation, the flooding focus also enables leveraging Clean Water Act funds as well as potentially unlocking new funding from FEMA and other sources directed toward hazard mitigation in addition to water quality.

The GI approach described for the three cities can be leveraged and is transferable across different geographic areas and scales.

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Thank you for your attention !

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