Hyper-geometry as an analysis framework for urban nature-based solutions

Summary

Given the challenges posed by climate change and its impacts, urban systems are likely to be more stressed than historically known. Due to the projected increased frequency, intensity, and persistence of high-impact natural phenomena (e.g. heat waves, or floods), along with changes in the exposure, the urban environment is left potentially vulnerable so long as it continues to rely solely upon conventional approaches, such as the use of grey infrastructure.

With a growing concern regarding the preservation of biodiversity-based ecological services, and knowledge expanding on the wide spectrum benefits offered by nature-based solutions – not only towards the natural and built environments, but also to the living biosphere – these are becoming an increasingly viable solution to many contemporary issues plaguing urban environments.

It is paramount to understand which green infrastructure implementations are most successful, and as their benefits are widespread, so too must their evaluation, particularly in the urban environment, where integration of these solutions is the most constrained. Based on both outputs and analysis and tweaking of the Storm Water Management Model (SWMM) calculation engine, and using novel mathematical methods in information physics and coevolutionary complexity, it becomes possible to assess relevant systemic connections in SWMM's Low Impact Development system and dynamically model an increasingly complex version, while retaining scalability, assuring easily understandable and physically consistent results.

In order to facilitate practical usage, the production of simplified results is of the highest relevance, so that impacts of considerable interventions on the urban fabric and other territories can be analyzed, predicted and aid in assuring the highest cost-efficiency while retaining the most possible positive results that can be integrated into day-to-day operations by staff with minimal training.

Keywords

Climate changes, urban nature-based solutions, *n*-dimensional geometry, non-linear complex systems, rain and stormwater runoff modelling, low-impact development systems, SWMM.

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