ABSTRACT TO THE PHDS IN TRANSITIONS CONFERENCE 2017

Dynamics of the Urban Metabolism

Submitted by JOÃO MEIRELLES DE MIRANDA

TRACK: Modeling and simulation of transitions

From the beginning of the 21st century, cities have become the main expression of spatial organization in society. Global sustainability is relying on our capacity of understanding and guiding urban systems in an effective way. We can do so by looking at the urban metabolism. The urban metabolism can be defined as the flows of energy and matter that pass through a city. It has been studied as a linear reactor, based on the concept of industrial ecology, with classical input-output analyses at the city level. This classical approach indicates a misunderstanding of the basic functioning of cities by not looking into the local level interactions and constraints driving the city-level metabolic flows. Cities can be seen as a paradigmatic examples of complex systems. This points towards an approach focusing on recognizing common patterns among cities, and looking at the form and the function of urban systems as the result of simple and universal laws that emerge from local level interactions. However, a bottom-up approach to the urban metabolism hasn't been constructed, making it hard to understand a city's metabolism in terms of its environmental and infrastructural dependence as well as its social micro-dynamics building blocks.

This research proposes an approach to understand how the urban metabolism changes as a city grows, by analysing existing literature on the urban metabolism, by developing of a method with which environmental impacts beyond the city borders but caused by the urban demand can be taken into account, by collecting this data in a database, and lastly, by developing an agent-based model coupled with cellular automata to test hypotheses regarding the causal loops behind urban metabolic processes. Information on the behavioural rules of agents should come from sociological theories. The model further has to take into account environmental constraints. In the model, the agents consume on a time-step basis. The population grows in time and with it, the spatiality of the city changes, forcing the agents to change their mobility patterns. Consumption patterns change too, due to changes in the micro-social dynamics, the specialization and the growth of the retail market. The city's infrastructure respects density limits. With the population growth the old sources of materials

and energy may not meet the city's demands any more. This forces the search for new supply sources, which have a spatial distribution similar to those found on nature.

Biography

JOÃO VITOR MEIRELLES DE MIRANDA
PhD Student in the Laboratory for Human-Environment Relations in Urban Systems
Ecole Polytechnique Fédérale de Lausanne

HERUS - IIE - ENAC - EPFL, Station 2, CH - 1015 Lausanne
joao.meirelles@epfl.ch
+41 21 693 59 77

João Meirelles holds a bachelor in Water Resources and Environmental Engineering from the Universidade Federal Fluminesne in Rio de Janeiro and a master in Complex Systems Modeling from the Universidade de São Paulo. He has worked as a Data Scientist at the big data team for the city of Rio de Janeiro. He is interested in applying big data analysis and complex systems thinking to the urban metabolism. He is currently enrolled in the PhD programme in environmental engineering at EPFL, and is a member of the Metabolism of Cities research group and the DATABASE project in Rio de Janeiro.