

**Plenary Talk** PLV X Thu 14:00 HSZ/0002  
**Towards a Science of Cities: A Complex Systems Approach**  
— ●MARTA GONZALEZ — UC Berkeley, USA

Cities are complex systems whose dynamics emerge from the interactions of millions of individuals, institutions, and infrastructures. In this talk, I present a framework that applies the principles of complex systems science to urban environments, aiming to uncover unifying patterns and mechanisms that govern urban behavior. Drawing on large-scale mobility, traffic, emissions, and financial transaction data, I show how cities can be studied as living laboratories of collective behavior. First, I examine the macroscopic dynamics of urban traffic, identifying critical thresholds that mark the onset and collapse of mobility systems

across different cities, and framing these collapses as nonequilibrium phase transitions. I then explore the environmental consequences of these dynamics, introducing a scalable model that links real-world mobility patterns to vehicular CO<sub>2</sub> emissions, highlighting the pivotal role of vehicle kilometers traveled. Shifting focus to spatial structure, I illustrate how mobility data reveals the transformation of urban form in response to disruptive events, such as pandemics, and offer novel metrics to quantify home-based travel and structural shifts. Finally, I demonstrate how behavioral regularities in credit card transaction sequences encode individual lifestyles and social structures, showing how economic activity reflects deeper patterns of urban life. Together, these studies underscore the value of a data-driven, systems-oriented approach to understanding and shaping the future of cities.