EXTENDED ABSTRACT ONLY

Adaptive human behavior and institutions in models of socio-environmental systems

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Abstract: Understanding and managing coupled social-environmental systems (SES) in the Anthropocene calls for an explicit representation of human agency in formal models. Evidence for regime shifts, adaptive behavior, changes in social norms and emergence of new socio-economic institutions – all reacting on and impacting environmental systems – grows. The simplified approach based on exogeneous scenarios of population, prices or GDP growth becomes increasingly insufficient to understand the dynamics of SES models, and consequently real SES where policy decisions, lives, livelihoods and ecosystems are at stake. Agent-based modeling (ABM) has developed as a method to simulate a number of heterogeneous adaptive agents – farmers, households, organizations or governments – that make decisions, learn and interact according to prescribed rules. In environmental modeling ABM is the preferred way to explicitly account for human behavior, and to quantify cumulative actions of various actors distributed over the spatial landscape. The number of ABMs explicitly simulating emergence and dynamics of formal and informal institutions, including markets and social norms, also increases. We witness more advanced, empirical ABMs being developed, with solid theoretical foundations for actors' behavior from social sciences, and integrating a variety of data sources to guide agents' behavior rules, interactions and learning in policy decision-support models.

In this talk I will discuss the state-of-the art in ABMs of SES and reflect on the open methodological challenges. In particular, I will elaborate on:

(i) the fact that there is a variety of social science theories that can provide microfoundations for agents' behavior when departing from rational optimizing assumptions and accommodating bounded rationality,

(ii) the possibilities to merge data from various sources, including GIS data, surveys, semi-structured interviews and even more qualitative data from stakeholders' workshops, and on how one can potentially use empirical data to address (i),

(iii) the implementation of learning in ABMs and use of machine learning methods to enable it,

(iv) scaling up of ABMs, since many of them are developed at urban and regional scales, while environmental models that that they need to talk to operate over larger geographical areas.

I will illustrate these issues going through a range of examples of ABMs of SES, including models of housing markets prone to urban floods, farmers facing droughts, and behavioral changes among households with respect to energy use.

Keywords: *Urbanization, resilience, floods, droughts, behavioral change, agent-based modeling*