Regime shifts of human-environment systems: historical analysis and modelling

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Abstract

To better understand cycles, thresholds, and shifting regimes in coupled human and ecological systems, approaches such as complex systems and resilience theory provide key concepts and knowledge. Examples of these shifting regimes in ecological systems have been known for a long time, for instance, in lakes and marine ecosystems. However, for the human domain, examples are less abundant, because of methodological constraints in conducting societal experiments. Complex systems theory helps identify important drivers, indicators, and dynamics to be modeled. Some basic research must still be done to prove that complex systems concepts are valid for real-world cases, including the societal dimension, i.e., these concepts can be verified with empirical data. We propose (qualitative and whenever possible quantitative) analysis of historical cases of regime shifts in coupled systems. This can be achieved by accessing historical documents and local knowledge and experts. Simulation with agent-based systems modeling (ABM) of artificial societies embedded in specific environments can then be applied to further investigate critical dynamics and use experimental settings for detecting early warning signals. In the dynamics of these processes we identify thresholds of system regime shifts in relation to other drivers and/or fast variables. For the design of ABM these processes provide insight where to put effort in follow-up historical data collections. These incorporations would improve involved ABM compared to other socio-ecological system models that have assumed slow-evolving processes being constant. The presentation will highlight a proposed project. Its main goal is to identify historical thresholds and regime shifts in three mountain societies. The focus is relationships among social, ecological, and technological variables over centuries. The aim is to understand decisions and assess awareness of intended and unintended consequences of different mountain societies in the Swiss and Austrian Alps.

Keywords: human–environment system, ecosystem services, historical analysis, regime, shifts, agent, based modeling

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