Landscape generation for a Land Use and Land Cover Change Agent-Based Model, with GAMA platform

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Abstract

The earth's surface is increasingly altered due to human activities, such as agricultural expansion or urban sprawl. Land change models have emerged over the past few decades to explore the causes and consequences of land use and land cover changes (LUCC) and to better forecast them in order to guide public policies. Agent-based models of LUCC (LUCC-ABMs) allows formalizing the interactions between society and environment through the modelling of heterogeneous stakeholders involved in land change and their individual decision-making process regarding to the land use, which has an impact on regional land cover. We introduce a LUCC-ABM of deforestation dynamics in Northern Ecuadorian Amazon, built with GAMA platform. The purpose of the model is to reproduce LUCC patterns due to human activities over eight years as they appeared between two land cover maps. To this end, we have developed a workflow based on i) a strong input of both qualitative and quantitative data at initialization step by a landscape generator based on census and survey data ii) livelihood strategies to typologize land use behaviours. Our model workflow can be described as following: after the data processing, we generate a spatially and socially structured population with a synthetic population generation library (GENSTAR) on the basis of census, cadastral and land cover data. Then, we assign a livelihood strategy to each household through a multi-criteria evaluation according to qualitative and spatial criteria from field surveys. Next, once again with GENSTAR, we generate an agricultural landscape for the entire study area by specifying a patchwork of farming activities in each plot assigned to these agents according to their livelihood strategy, on the basis of field survey data in a sparse remote sensing data context. Lastly, we calibrate parameters related to agent decision-making processes in order to better reproduce environmental dynamics. In addition to a contribution on the integration of data in LUCC-ABMs, this work aims to investigate the connection between pattern-based and process-based modelling of LUCC.

Additional material

Link to the repository : https://github.com/rmejean/nea-lucc-abm