Modelling spatial aspects of forest-savanna dynamics - An educational web-based tool

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Description

Spatial interaction rules that govern ecosystem function are relatively easy to hypothesise, and yet the consequences for global behaviour are not always so obvious. A small number of rules, by invoking a variety of slow and fast feedback mechanisms, will produce highly complex outcomes. This is a recurrent theme that is addressed in the study of 'Complex Adaptive Systems' (CAS).

Students that interact with Cellular Automata (CA) based models can learn about an ecosystem's behaviour and how it is affected by various management actions. Learning by 'composing' alternative behaviours and testing their consequences may generate a more sustained learning experience for the student that will allow them to develop new intuitions. Our model of forest-savanna dynamics, and the Modelling4All platform on which it is hosted, aims to provide a test of how much students can learn from this approach.

The model is a reimplementation of the one presented in Hochberg et al. (1994) showing the dynamics of forest and savanna areas in the presence of seasonal fire events. Different processes and parameterisations are analysed in terms of their influence upon the spread of trees in the CA environment. Though it was originally designed for research, we have reimplemented this model in NetLogo on the Modelling4All platform as a pedagogical tool. We plan to extend the model to consider the role of human actors, and to encourage its users to consider issues of sustainable resource management.

The teaching materials progress the student through a set of learning exercises with the model. At each stage a number of questions are asked: If we increment the number of total mature trees in the beginning does it make any difference (% increase/decrease) in the total number of mature trees after a certain number of years ? Why ?; Does the occurrence of fire in a certain year make any difference in the total number of mature trees after a certain number of years ?; In the case you have fire in a certain year, how many years will your model need to recover?

The Modelling4All platform on which the model is hosted, is itself based on NetLogo coding. The modelling environment runs in any web browser, offers an intuitive interface of buttons and check boxes for exploring various options, and most importantly for student collaboration allows sharing of models (via http links). The materials will be presented and tested through use with two classes in Brazil. Evaluation and feedback from the classes will be collected.

References

Hochberg, M. E.; Menaut, J. E.; Gignoux, J. The Influences of tree biology and fire in the spatial structure of the West African savannah. **Journal of Ecology** V. 82, pp 217-226 , 1994.

Keywords

environmental education, modelling in education, agent-based modelling**.**