



The LUE data model for representation of agents and fields

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Traditionally, agents-based and field-based modelling environments use different data models to represent the state of information they manipulate. In agent-based modelling, involving the representation of phenomena as objects bounded in space and time, agents are often represented by classes, each of which represents a particular kind of agent and all its properties. Such classes can be used to represent entities like people, birds, cars and countries. In field-based modelling, involving the representation of the environment as continuous fields, fields are often represented by a discretization of space, using multidimensional arrays, each storing mostly a single attribute. Such arrays can be used to represent the elevation of the land-surface, the pH of the soil, or the population density in an area, for example. Representing a population of agents by class instances grouped in collections is an intuitive way of organizing information. A drawback, though, is that models in which class instances grouping properties are stored in collections are less efficient (execute slower) than models in which collections of properties are grouped. The field representation, on the other hand, is convenient for the efficient execution of models. Another drawback is that, because the data models used are so different, integrating agent-based and field-based models becomes difficult, since the model builder has to deal with multiple concepts, and often multiple modelling environments.

With the development of the LUE data model [1] we aim at representing agents and fields within a single paradigm, by combining the advantages of the data models used in agent-based and field-based data modelling. This removes the barrier for writing integrated agent-based and field-based models. The resulting data model is intuitive to use and allows for efficient execution of models. LUE is both a high-level conceptual data model and a low-level physical data model. The LUE conceptual data model is a generalization of the data models used in agent-based and field-based modelling. The LUE physical data model [2] is an implementation of the LUE conceptual data model in HDF5.

In our presentation we will provide details of our approach to organizing information about agents and fields. We will show examples of agent and field data represented by the conceptual and physical data model.

References:

- [1] de Bakker, M.P., de Jong, K., Schmitz, O., Karssenber, D., 2016. Design and demonstration of a data model to integrate agent-based and field-based modelling. *Environmental Modelling and Software*. <http://dx.doi.org/10.1016/j.envsoft.2016.11.016>
- [2] de Jong, K., 2017. LUE source code. <https://github.com/pcraster/lue>