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Agent-based modelling – modern tool for catchment monitoring

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One of the most prospective bottom-up approach for human-environment relations modelling is agent-based modelling (ABM). ABM is a modern technique more and more often used in Geographical Information Science. It is based on entities called agents which can make spatial decisions. They can also exchange information with each other. Moreover, they have attributes which allow to describe their actual state. In classical approach to modelling all entities are often quite similar. It is possible to create a model with very similar entities within ABM. These entities can have slightly different behaviours. Agents can have identical attributes and very different decision rules. It allows a user for applying randomness in a model which is really crucial in environmental studies. Agent-based simulation as a modelling approach, and also agent-based simulation software, has not arisen out of the traditional modelling and simulation or operation research fields. ABM and simulation can be traced to investigations into complex adaptive systems, the evolution of cooperation and artificial life. Unlike other modelling approaches, ABM begins and ends with the agent's perspective. The application of ABM to simulating dynamics within GIS has seen a considerable increase over the last decade. ABM allows the disaggregation of systems into individual components that can potentially have their own characteristics and rule sets.

The main goal of presented work was to identify, determine and understand the interactions between geoecological and sociological aspect of catchment functioning in Poznań Lakeland District, Poland. A very big geodatabase as well as lake nutrient content data were collected and used in decision making process. Agent-based simulations were performed using Non-quite Python (NQPy) programming language which is Python language extension used in GIS. Agent's environment was described using spatial data collected and stored in geodatabase. Dynamic agents represent catchments in the model. They can describe their own state of functioning analysing spatial, land-cover and nutrient content data. They read spatial data and performed spatial analysis to change their actual state and they did it by themselves. Sensitivity analysis was then performed to identify most important factors influencing catchment functioning. Simulations allowed to describe the importance of each factor in the evaluation of catchment functioning. This work shows which factors play the most crucial roles in postglacial catchment system functioning.