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ATLAS: A Tool to Model Spatial-temporal Dynamics of Processes Influencing Ecosystem Services

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Abstract: Biodiversity provides various benefits to humankind throughout what is defined as ecosystem services. Within a specific ecosystem, a wide range of ecosystem services can be identified. During the past decades, human intervention has aimed to increase some services such as food production through agricultural intensification, at the expense of other services such as water regulation. Mapping, evaluating and quantifying each of these ecosystem services provided by biodiversity to crop production could help to increase the multi-functionality of agricultural landscapes. In this context, we developed a spatially-explicit model called **ATLAS** (Agricultural LandscAPE Simulator). **ATLAS** aims in simulating realistic spatio-temporal dynamics of agricultural landscapes, through crop rotations and phenology at the landscape scale. The robustness of the model was evaluated using two criteria: an accurate composition (crop area) and configuration (crop clustering) of crops. Here, we show the potential of such a tool to map and evaluate ecosystem services through the simulation of underlying ecological processes. We applied this model to two case studies: control of pests and crop pollination. First, we studied how the dynamics of a cereal aphid, *Rhopalosiphum padi*, respond to spatial-temporal crop availability. Second, we developed an extension to model spatial-temporal dynamics of flower resources in relation to wild pollinators and pollination. With a low amount of inputs and calibration needed in **ATLAS**, the impact of agricultural practices on ecosystem services can thus be explored to allow better comprehension and management.*

Keywords: *Spatialised model, Agricultural landscapes, Ecosystem services, Pollination, Pest regulation*