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Extending the multi-agent modelling platform MAELIA to support land conversion to agroforestry systems

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Background
European policies are encouraging the development of agricultural practices such as agroforestry, which are promoting both provisioning and regulating ecosystem services. To help decision support, there is a need to develop tools able to evaluate the environmental, economic and social impacts of converting existing agricultural land to agroforestry. The MAELIA platform (Multi-Agents for Environmental norms Impact Assessment http://maelia-platform.inra.fr/) has been developed to handle interactions between agricultural activities, agricultural landscape dynamics and the management of natural resources at the landscape level. MAELIA is currently able to simulate the development, yield, gross margins, and workload of arable crops and grasslands and their interactions with water, nitrogen and carbon dynamics in soils.
Objectives
The aim of this work is to extend the functionalities of MAELIA a) to simulate growth of trees and their biophysical interactions with intercropping crops and grasslands, and b) to implement management strategies in agroforestry systems.
Methods
Growth of trees and their temporal and spatial interactions with crops regarding competition for light and water will be implemented into MAELIA at a daily time step. A light response curve will be adopted to simulate carbon assimilation, which will also be regulated by water availability (Granier et al., 2007) and temperature (Sitch et al., 2003). Allometric relationships will be used to allocate biomass in trees and hence describe tree growth. Water dynamics in the soil-plant-atmosphere system will be described similar to the BILJOU water balance model (Granier et al., 1999), considering competition between plants for soil water. Light under the canopy will be simulated by implementing the CanSPART radiative transfer model (Haverd et al., 2012).
Information on management strategies in agroforestry systems will be collected to parameterize the decision rules that allow simulating the dynamics of technical operations applied by farmers (Murgue et al., 2016). These data will also be used to parameterize the economic module of MAELIA.
Calibration and validation of the platform will be performed using 1) an in-depth analysis of biophysical processes from an instrumented experimental site, and 2) data on a subset of processes from 6 other field sites to encompass diverse pedoclimatic conditions and plant associations.
Expected results and perspectives
Robust representation and simulation of plant growth and water fluxes in temperate agroforestry systems are expected from MAELIA after implementation of the above biophysical processes. The environmental and socio-economic impacts of scenarios regarding introduction of alley cropping systems in a French temperate region will then be assessed. Ongoing developments in MAELIA will allow in the future to address further issues related to carbon and nutrient cycling in agroforestry systems.

Keywords: Multi-agent platform, Integrated assessment and modelling, Biophysical processes, Landscape-scale, Temperate systems.

References:

1. Granier et al., 1999, Ecol. Model. 116, 269–283, 10.1016/S0304-3800(98)00205-1
2. Granier et al., 2007, Agric. For. Meteorol. 143, 123–145, 10.1016/j.agrformet.2006.12.004
3. Haverd et al., 2012, Agric. For. Meteorol. 160, 14–35, 10.1016/j.agrformet.2012.01.018
4. Murgue et al., 2016, Land Use Policy 54, 339–354, 10.1016/j.landusepol.2016.02.020
5. Sitch et al., 2003, Glob. Change Biol. 9, 161–185, 10.1046/j.1365-2486.2003.00569.x