Report describing the ABM applications to the case studies
The agent-based model (ABM) of land use change developed for application at the European scale in the VOLANTE project is described in detail in this Deliverable. Section 1 explains the structure and functioning of the model, Section 2 describes a literature meta-analysis conducted to support model development, and Section 3 lists the inputs required to establish a final European model along with possible data sources for these inputs. Example theoretical applications of the model are also presented.

The ABM presented here can be used in relatively small, focused applications such as the VOLANTE case studies, but can also be applied at very large spatial scales, where considerable variation exists between land uses and between land managers. Within the VOLANTE project, the model is now intended for application at EU scale, where it will provide a basis for comparison with ‘top-down’ models of land use change being developed in Work Package 7, which do not account for land manager (agent) behaviour. The ABM will therefore also allow consideration of the effects of human behaviour as part of the roadmapping process (Work Package 13).

The full list of design criteria for the model are as follows:

1) The model must be able to run at European scale. This requirement holds for runtime costs, complexity, and the availability of data to parameterise and calibrate the model.

2) The model should take into account the full range of societal demands, including those which are not explicitly defined in monetary terms such as preservation of nature.

3) The model must be able to represent multifunctional land use, and be responsive to the trade-offs between provision of various services.

4) The model should be able to represent the diversity of human behaviour and land management found across the EU.

5) The model should be easy to refine and extend – in terms of scale and complexity – from simple, stylistic examples to empirically-based case studies, and up to a full European simulation. This includes incorporating different sets of services, capitals, land uses and agents, as well as adding complexity and variation to individual agents.

Results from the meta-analysis (Section 2) inform about the drivers of recent agricultural land use changes, and can therefore inform the design of agent-based land-use models such as the VOLANTE ABM. It informs about the different agents involved in agricultural land use changes, their decision-making processes and the factors that influence these decisions.

We show that a simple, flexible ABM framework capable of modelling land use change in considerable detail and/or at very large scales could make a valuable contribution to land use science. We also show that the model is currently able to reproduce a number of important land use processes using simple settings, and outlined the steps necessary to apply the model to our own intended study and to others, including the requirements for model parameterisation at the European scale (Section 3).

The future development of the ABM will focus on its application to large scales and its ability to accurately describe and simulate human behaviour. This will allow us to generate examples of future land use change in Europe under a range of political, social, economic and environmental scenarios, and provide results for comparison with top-down land allocation models. It will also make the model a valuable tool for modelling large or small-scale processes of land use change and, we hope, enable research into topics that have previously been too large or complex for study using land use ABMs.