

Year of CfP: 2008

Project No 0803-021 Completed

Project title: Model level integration for understanding and managing human influenced ecosystems at the landscape scale

Units managing the project: LISAH, Laboratory for soils, Agrosystems, Hydrosystems Interaction studies (INRA, IRD, Montpellier SupAgro) and AMAP, Botany and computational plant architecture (CIRAD, CNRS, INRA, IRD, UMII)

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Research units from the Foundation's scientific network involved: DIADE, Innovation

Sub-thematic axes: IPB-1 (Integrative Plant Biology 1: *Genetics and genomics, plant breeding, ecophysiology*), STDI-1 (Socio-Technical Dynamics of Innovation 1: *Agri-environmental innovations, agri-ecosystems, resources management*), STDI-3 (Socio-Technical Dynamics of Innovation 3: *Innovation processes, social management of innovations*)

Objectives:

There is great need for scientific-based, user-friendly, game-like platforms for integrative landscape modelling, which would enable either scientists or multiple stakeholders to test their landscape design ideas in the light of economic, ecological and environmental targets. Such platform development needs to integrate knowledge from different disciplines in order to provide effective solutions for real-world problems. A few interdisciplinary studies have already been conducted related to integrative landscape modeling. They generally consisted in integrating social, economic, and ecological aspects for a sustainable development. It appears however that no study has been carried out on complete integrative landscape approaches including bio-physical, ecological and socio-economic processes.

One of the strongest barrier for discussing the concepts in interdisciplinarity or transdisciplinarity project is the lack of understanding. The notion of ontology in computer science is more and more advocated for representing the domain knowledge and supporting multi-disciplinary integration but few works have been carried out in this area.

We propose in this project to tackle the issue of integrative ecosystems & landscape modelling by first studying states-of-art in the various concerned disciplines, and by a prior analysis of the main conceptual gaps. In most projects concerned with the development of integrative landscape modelling, the approach was either to extend a prior model in a given scientific domain by coupling it with models from other domains, or to couple in a weak manner existing models in order to obtain an integrative model. In both cases, the developed modelling structures often lack genericness and/or capacity to represent accurately the main multidisciplinary interactions between processes. By starting prior to platform and model development, an in-depth evaluation of the interdisciplinary conceptual gaps and needs for designing an integrative landscape modelling platform, it is expected to overcome the above mentioned problems and to design the main desirable characteristics of a generic and shared platform.

This work will allow defining the conceptual basis of an integrative and interdisciplinary (socio-economy, agronomy, biology, ecology, hydrology...) approach, in order to further develop a modelling platform of "ecosystems & landscape functioning under human influence".

Action carried-out and results obtained:

There is definitely a great need for scientific-based, user-friendly, game-like platforms for integrative landscape modelling, enabling either scientists or multiple stakeholders to test their landscape design and management ideas in the light of economical, ecological and environmental

constraints. The development of such platforms needs to integrate knowledge from different disciplines in order to provide effective solutions for real-world problems. For this purpose, two projects were set up within the advanced thematic research network "Montpellier Agricultural Sciences and Sustainable Development", funded by Agropolis Foundation. The projects are entitled "Integrative landscape modelling" and "Towards a federative research on modelling and simulation platforms".

Their objective was to put together various teams, each of them having developed, with a specific scientific focus, its own model or platform for simulating landscape structure and functioning. The challenge is to manage to link these models and platforms in a general conceptual and modelling framework, enabling to consider the main biological, physical, geographical and socio-economical interactions impacting ecosystems and landscape functioning and management. These projects constituted a first step for all partners to share their background experience in their own discipline (ecology, agronomy, hydrology, socio-economy) and further try to define a roadmap for building an integrative modelling platform.

These two projects have been carried-out in very close cooperation, the first one focusing on thematic issues and the second one being its methodological counterpart. In consequence, the results of the two projects are presented together.

The projects started in February 2009 and ended in December 2010. During the time-course of the projects, three thematic workshops have been organized, implying a total of around 50 members of the participating research units. An international conference on integrative landscape modeling was also set up, with a worldwide-recognized scientific committee. The event attracted more than one hundred participants from all over the world. Fifty-two researchers presented their ongoing work and three round-table allowed discussions about hot topics of landscape modeling and simulation. In total, sixteen scientists were invited to present their work and feed the discussions.

As a result, the proceedings of the international conference were published, gathering thirty-seven scientific communications (www.symposcience.org). A website was built-up to capitalize information and discussions generated by the projects (<http://www.umn-lisah.fr/rtra-projects/>). A state of the art of integrative landscape modeling was written, from bibliographic data and exchanges within the scientific community.

The projects allowed reinforcing the links both within the Montpellier-based research community and with the national and international scientific community (METISSE Network, Réseau National des Systèmes Complexes, Global Land Project, etc.). In addition, the outputs of the projects have been highlighted through various publications and communications towards the local, national and international communities around landscape modeling. Finally, the projects gave rise to several concrete research collaborations at various levels.

Publications

Farolfi S., Müller J.P., Bonte B.. 2010. An iterative construction of multi-agent models to represent water supply and demand dynamics at the catchment level. *Environmental modelling and software*, 25 (10) : 1130-1148.

Gumiere, S., Raclot, D., Cheviron, B., Davy, G., Louchart, X., Fabre, J. C. & LeBissonais, Y., 2010. MHYDAS-Erosion a distributed single-storm water erosion model for agricultural catchment. *Hydrological Processes*, <http://dx.doi.org/10.1002/hyp.7931>.

Lagacherie, P., Rabotin, M., Colin, F., Moussa, R. & Voltz, M. Geo-MHYDAS: A landscape discretization tool for distributed hydrological modeling of cultivated areas. *Computers & Geosciences*, August. 2010, 36, 1021-1032.

Total Agropolis Fondation funding: € 60,125 (salary for an engineer, travel expenses, one international and 3 internal workshops organisation)

Funding categorie(s): Agropolis Fondation small grants (support for the organisation of high-level scientific events e.g. conferences, seminars)

Project duration: 1 November 2008 – 07 April 2011

Keywords: ecosystems – landscape – modelling – platform