List of abstracts

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Modelling biodiversity in landscapes: habitat modelling

There is growing interest in the multiple uses and benefits society gets from land and environmental systems. This combines with long-held recognition of the importance of biodiversity, to provide an increased need to understand habitats, their ecological relationships in landscapes, and their role and value in the context of ecosystem services.
Habitat modelling, especially when linked with Geographic Infoomation Systems, is an important and powerful scientific and applied tool for spatial representation and potentially for developing understanding of landscapes, habitats, biodiversity, and ecosystem services. This paper addresses different approaches to habitat modelling. Four different general approaches are discussed;
The four These are:
i)Modelling representation(s) of habitat,
ii)Modelling links between habitat and biodiversity,
iii)Modelling habitat dynamics, and
iv)Modelling population dynamics and habitat.
The four approaches illustrate not only different methodologies, but also concerns for different aspects of landscapes, ecosystems and biodiversity. They also address very different scientific and practical questions.

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Forest and natural ecosystem managers in the landscape – multiscale modelling, challenges and opportunities

Forest and natural ecosystem management operations are generally planned and implemented on individual land management units, at the community or ecosystem scale: field, plot, woodlot... But the effects of such operations on neighbouring units are often poorly taken into account. In addition, under changing environmental, regulatory, and economic conditions, it is increasingly important to address sustainable management at larger scales. Managers increasingly require advanced decision support tools (DSS = Decision Support Systems), such as expert and knowledge based systems, multi-criteria techniques as well as communication and visualization tools.
Many models address environmental and ecological processes at the field, forest stand or agricultural activity scale, but they rarely capture interactions between farming, silvicultural or ecological engineering practices and potential impacts on the landscape. In this presentation we shall outline some of the challenges modellers are facing in applied ecology, when moving upwards from plant to community and landscape. Several examples will be taken from recent and on-going integrated projects, focusing on decision support systems, aiming at improving connections between scientists and management practitioners for developing and implementing techniques in ecological engineering and ecosystem management.

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Socio-economic Assessment of the rural Vulnerability of water users under stressors of global changes in the Hard rock area of South India. The SHIVA ANR project.

Vulnerability assessment is in growing demand in policy circles in order to choose adapted measures and policies to reduce vulnerability of water users and resources. Within the SHIVA ANR project, we present a method to first assess and map the vulnerability of South-Indian farmers to both climate and socioeconomic changes, and second assess the costs and benefits associated with farmers' vulnerability evolution at two time scales (medium and long term). The project is focusing on hard rocks area of South-India as in this geological context, both surface and ground water resources are naturally limited. We also target farmers' population as they are the main water users of the area and they rely exclusively on groundwater. By the end, the area covers the semi-arid zone of South-India, with a rainfall gradient from 1100 mm to 600 mm. Vulnerability is then expected to vary according to this local climatic conditions but also to socioeconomic characteristics of farmers' households. After a 10 months research, we present the first results of the project.

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Semi-virtual simulations of agricultural and land management practices in Languedoc Vineyards: a way to deal with incomplete knowledges of spatial distributions in landscapes

We present methods that aim to simulate spatial distributions of Land Management Practices (LMP) at high spatial resolution and over large extents as required by spatially distributed environmental modelling. The principle of theses methods, inspired from geostatistical conditional simulations techniques, is to simulate a set of equally possible spatial patterns that all respect the knowledge that have been collected on the location of the landscape features, i.e; spatial laws and data (descriptive approach); and/or the driven factors of the studied LMP (factorial approach). The differences between the simulated spatial patterns can be seen as a representation of the spatial uncertainty. To illustrate these methods, two examples of simulations of spatial patterns of LMP are presented. They involved specific methodological developments and can be considered as representative of descriptive and factorial mapping approaches respectively, i) the simulation of ditch network reconstructed from an incomplete set of reaches observed by remote sensing and ii) the spatial simulation of weed control practices at plot scale from a set of driven and correlated factors.

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Auctions in agri-environmental policies when the spatial pattern of natural habitat counts

The aim of this paper is to compare different policy instruments for cost-effective habitat conservation on agricultural lands, when the desired spatial pattern of reserves is a random mosaic. We use a spatially explicit mathematical programming model called OUTOPIE, applied to a Natura 2000 site in France (Plaine de Niort), designed to protect a bird specie called the Little Bustard. This economic model studies the farmers' behavior as profit maximizers under technical and administrative constraints. Facing different policy measures, each farmer chooses its land-use at the field level, which determines the landscape at the regional level. A spatial pattern index (Ripley L function) is then associated to the obtained landscape, indicating on the degree of dispersion of the reserve. We compare two forms of subsidies per hectare of reserve (uniform and graduated) and an auction scheme. The auction is based on bids from landowners indicating the minimum compensation payment they need to enroll one additional hectare of their land in the reserve. We find that the auction is superior to the uniform subsidy both for cost-efficiency and regarding the spatial pattern of the reserve. The auction is more cost-efficient than the graduated subsidy but yields a less satisfying spatial pattern.

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A generic model of interdepences between agents and water

This paper presents the on-going development of a generic model of a society with various sources of localized interactions with water resource. It encompasses direct interactions among agents, who are supposed to be heterogeneous: we have the aim to cover situations featuring rural / urban interdependences. It includes as well interactions between water resource and agents. These interactions depend on the quantity and quality of water present at suitable place according to the expectations of the agent. It takes in account fluxes and evolution of resource from one place to another as they may be engineered by actions of agents. Altogether it leads to represent indirect interactions among agents: the availability and quality of resource in place P1 which is meaningful for agent A1 is modified by action of agent A2 in place P2. This induces interdependence between A1 and A2. The question is then whether this interdependence is matched by other relations between A1 and A2. It is dealt with the representation of possible fluxes of information between agents. Our generic model is based on Agent Group Role architecture. It includes an explicit representation of space and topological relations, as well as a taxonomy of possible activities performed by agents in relation with water resource. On the social side, it takes in charge frameworks of institutional analysis as formalized by Ostrom and colleagues as well as regimes of engagement, as formalized by Thévenot and colleagues.

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Tuning a land use change model with socio-economic data

We modeled land use change in a study area (270 km²) in South-West China. We hypothesized that we can only model the land use change pattern adequately if we included physical drivers as well as local socio-economic conditions and governmental regulations.
We applied the CLUE-S land use change model considering physical (elevation, distance to river, exposition) and socio-economic (distance to road/village/collective land, designation as state/ collective land, available labor, and ethnicity) factors, and governmental regulations. The socio-economic factors were referenced to space (in this case to the village area) for the model. Participatory mapping was applied to create village boundaries.
Physical factors alone could not explain the highly differentiated land use pattern (dryland, irrigated land, shifting land, rubber, tea, settlement, forest) in the study area. In China, collective land and state land are distinguished. Farming usually is restricted to collective land. This land designation turned out to be the most important factor for the land use types dryland, irrigated land, and rubber. We achieved further spatial differentiation when we related available labor to only the agricultural area of the villages (by cutting out forest areas). All land use types were influenced by the ethnicity of village inhabitants, because they had different land use traditions.
Due to data inaccessibility we could only apply a small number of physical factors. Integration of other physical factors may improve model results. But in the model run we could show that land use patterns in the study area were closely related to socio-economic characteristics and governmental rules.

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Layers dependencies specifications in the APILand simulation approach: an application to the coupling of a farm model and a carabid model

The coupling of models is one way to make simulation model. In that kind of simulation modelling, there are three way to manage the space. The first is implicit, the second is dealing the space as a simple variable and the third manage the landscape as a specific model. APILand is an object-oriented library which notably allows making spatial simulation models in that last way. As in GIS domain, the landscape model is defined as a set of overlapped layers. At this point, three kinds of links between layers have been used through APILand simulation experience: i) sharing when models have the same definition of “landscape”, ii) translation when there is a hierarchical perception of space and iii) inclusion when there a double communication of the external models. The coupling of a farm management model with a carabid model shows that managing the landscape as a specific model allows a lower dependency between models. It makes also possible to reuse a part of the model in order to extend it.

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Predicting species distribution responses in Mediterranean dynamic landscapes in a context of global change: modelling challenges and the way forward

The current challenge in a context of major environmental changes that will be exacerbated in the future is to allow a meaningful projection of species distribution to future landscape and climate scenarios. Species distribution modelling may play a fundamental role in this challenge but we need to integrate more ecology in model building and develop more coherent model validation before species distribution modelling may be of use in a dynamic ecological context.Mediterranean landscapes are highly dynamic systems. Fire is one the most powerful driving forces of these dynamics and in the Mediterranean basin its frequency and impact have markedly increased in recent years. The description and analysis of landscape patterns associated to fire dynamics have received some attention but knowledge about how the temporal and spatial arrangement of habitats arising from wild fires affects wild animals is astonishingly poor with the exception of within habitat succession related recovery of communities after the disturbance event. In this communication, we present recent advancements on bird species responses to fire in Catalonia (North-east Iberian peninsula) in which species distribution modelling applications have played a major role. Our study model in dynamic Mediterranean landscapes has stressed the importance of landscape dynamics, population connectivity and model building in the accurate prediction of distribution changes of bird species in response to fire dynamics during the last 20 years in the region. We argue that a deep insight on the temporal and spatial factors that interact in a complex way to determine current landscape patterns and species responses will be essential if we aim at understanding and managing Mediterranean systems. The generality of these constraints suggest that successful application of species distribution modelling to the prediction of species distribution dynamics in other systems should be developed under a similar integrative, ecological sound framework.

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Developing a nested-scale landscape modelling framework for ecosystem services

A nested-scale framework of land use scenarios is proposed to support the assessment of ecosystem services. The approach uses a single modelling tool, LandSFACTS, to create potential landscapes corresponding to the desired scenarios. The model considers simple spatio-temporal constraints on cropping systems or land uses; and its inputs are adaptable to the scale of study and the scenario needs. The created potential landscapes can then be assessed for ecosystem services such as habitat networks, food security. The common approach between the scales will support the flows of constraints and conclusions between the individual scenarios, and thus will facilitate a coherent assessment of ecosystem services across scales. The framework is currently being applied to the North-East of Scotland, in the Grampian administrative area, the Dee catchment and Tarland sub-catchment. Preliminary conclusions are reported.

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Optimizing the landscape patterning of fuel treatment of road corridors to reduce fire hazard

A large part of the points of ignition of wildfires are aggregated at the vicinity of roads in French Mediterranean areas. As a consequence, managing the road corridors (= linear interfaces between roads and wildlands) is critical to limit fire hazard and the vulnerability of ecosystems located near road networks.
We present a simulation study of fire spread using a cellular automaton. our objective was to minimize fire hazard and the area of fuel treatment. We used statistical optimization methods to test the different management scanerios. The spatial patterning of fuels and of the fuel treatments (i.e. grass mowing, shrub-clearing) clearly affected the probability of fire and propagation. Fire hazard can be minimized using low-flammable dicot grasses and regularly mowing the very flammable graminoids at strategic places. The high fire hazard level of mixed vegetation can be lowered by a selective fuel treatment. Managing about 20% of road corridor can strongly reduce fire hazard in interfaces dominated by highly flammable vegetation.
If the location of the points of ignition can be predicted accurately, fuel treatments can be strictly delimited but very effective. If this location is random or unknown, fuel treatments should be operated on a large scale and directed towards the most flammable vegetation communities. Landscape simulation of management practices is critical to limit the vulnerability of ecosystems in a context of global change.

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3D soil layers reconstitution through landscape modelling and sparse soil measurements

This work presents an approach developed to generate 3D soil continuous layers from sparse measurements of soil properties taken at different soil depths and Digital Elevation Models (DEM) computed for the different layers. The approach is generic in the sense that it mainly involves landscape modelling and 2D interpolation techniques and could thus be carried out in any soil-landscape context. Applied in a real case, it allowed soil scientists to highlight processes omitted in previous 2D approaches.

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Connectivity and landscape patterns in human dominated landscape: a case study with the common frog Rana temporaria

Landscape connectivity is considered a key issue for biodiversity conservation and for the maintenance of natural ecosystems stability and integrity. Landscape connectivity defines the degree to which the landscape facilitates or impedes movement among resource patches. Amphibian's life cycle involve seasonal migrations between terrestrial and aquatic habitats which constrain them to regularly cross an inhospitable fragmented landscape matrix. Thus, there is a growing need for maintaining and restoring landscape connectivity between their habitat patches. This is especially the case for the common frog Rana temporaria, a widespread amphibian in Europe occurring in various habitat types and migrating between forest habitat and aquatic habitat for breeding.
The aim of this study is to provide a method based on forest patches distribution and configuration in order to assess in which manner certain habitat patches can affect common frog habitat availability and landscape connectivity by the use of graph theory.
We first achieved a suitable habitat patches distribution map by the use of presence data and maximum entropy modelling. We used land use distribution, distances to forest patches and rivers, and landscape indices computed with a Morphological Spatial Pattern Analysis (MSPA) as the main significant environmental variables influencing habitat patches distribution. Then, we used least cost modelling and graph theory by the use of the software Conefor Sensinode 2.2 in order to highlight the main habitat patches influencing habitat availability and landscape connectivity.
This method combined with the use of genetic markers allowed to assess the main barriers and corridors for the common frog. This results emphasize the potential of maximum entropy modelling, Morphological Spatial Pattern Analysis and graph theory for integrating connectivity in landscape planning.

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OpenFluid: a software environment for modelling fluxes in landscapes

Farmed landscape functioning and changes in time and space are mainly influenced by multiple bio-physical processes, human activities, socio-economic driving factors and by the interactions between all of them, resulting in a complex multi-scale system. Thus, modelling and simulation of such systems is very hard and requires both solid scientific background and development of specific software tools.
The OpenFLUID platform was developed in this way, and provides a modern, flexible and easy-to-use modelling framework allowing and facilitating the implementation and/or development of single process components to be used, reused and coupled according to the modelling objectives, the spatial scale and the data. OpenFLUID is mainly based on a spatially distributed modelling approach, where elements and spatial patterns of the landscape are in interaction with the simulated processes (e.g. agro-bio-physical fluxes) and can influence or be influenced each-other.
We describe here the main components of the OpenFLUID platform and their objectives, basic principles and technical features: the simulation engine (OpenFLUID-Engine), the graphical user interface (OpenFLUID-Builder) and the community web site (OpenFLUID-web). The major OpenFLUID improvements and perspectives are also presented.

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Chances and limits of using landscape metrics within the interactive planning tool "Pimp Your Landscape"

Global Change requests land use management to adapt to changing frame conditions, e.g. effects of climate change for agriculture and forestry. We developed an interactive planning tool, Pimp Your Landscape (PYL), which allows evaluation and visualization of land-use scenarios. A major shortcoming of the approach "cellular automaton" is that landscape functions cannot be appraised by only looking at the quantity of cells, but neglecting location and patterns of cell clusters. Hence, we propose the implementation of landscape metrics (LMs), which will up- or devalue key functions, e.g. biodiversity and landscape aesthetics at landscape level. We tested widely used LMs, which allow concluding on diversity and aesthetics. For calculating LMs we employed Fragstats 3.3 for a test-area in Saxony. We found a lack of consistency of evaluation results for different scale levels, which might cause problems in the use of PYL at different scales. LMs react differently by changing scales. Most useful landscape metrics for an evaluation of landscape aesthetics are 'Edge Density' and the 'Shape Index'. For assessment of biodiversity and spatial diversity nearest neighbor- and diversity-metrics like 'Shannon's Diversity Index' or 'Shannon's Evenness Index' are useful. The final integration of LMs into PYL is a future task. The conceptual planning aims at the most efficient way of integrating LMs on the one hand and most possible user friendliness of Pimp Your Landscape on the other hand.

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Pimp your landscape – a cellular automaton approach to estimate the effects of land-use-pattern changes on environmental services

Pimp your landscape is a software tool, which was developed to facilitate the evaluation of different land-use management scenarios regarding the impact of land-use pattern changes on environmental services. The software uses digital information relating to land-use (Corine Landcover 2000, national landcover maps), climatic parameters (rainfall / temperature, water balance, risks), geology and topography.
The mathematical approach of the software is a cellular automaton with Moore-Neighbourhoodship, which helps to consider neighbourhood effects between different land-use forms and to integrate also the effect of environmental attributes into the integrative evaluation of land-use pattern changes on landscape level.
The evaluation of the value of each land-use form for environmental services under consideration of the specific environmental frame conditions of each cell is based on a hierarchic rule based evaluation approach. For supporting the user in understanding the functioning of the "system landscape" landscape, the software offers the opportunity to define, activate and deactivate evaluation rules considering the impact of environmental parameters (weight, importance for the value of a land-use form for an environmental service) and neighbourhood effects (gradient, positive / negative impacts). Furthermore, restrictions from the planning practice can be introduced, such as reservation areas or areas with priority for a certain land-use form.
Actually the software is adapted to test land-use management related climate change mitigation strategies in a regional context and some experiences (results, scale-level problems, evaluation problems, application restrictions) are put up for discussion.

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A multidisciplinary modelling approach to understand the effects of landscape dynamics on biodiversity

Over the last 40 years, agricultural extension and intensification of land use have induced profound changes in distribution and dynamics of farmland biodiversity and in the functioning of European agroecosystems. Agroecosystems are mainly private properties, whose dynamics need to be better understood in order to preserve their biodiversity. Several French research teams have recently joined their skills in a multi-disciplinary project, BiodivAgriM, whose main goal is to test, validate, and predict the consequences of different scenarii of landscape changes on the distribution, abundance and persistence of biodiversity in agroecosystems. A central goal of this project is to generate a multi-purpose modelling platform which makes it possible to couple different spatially explicit models toward the same objective, and gather rather similar models toward the same generic object (i.e., the landscape). Such a modelling approach is a real challenge. The main knowledge provided by this project was that the disciplines involved were in various maturation stages, with respect to the modelling approach, to understand the impacts of agricultural practices on biodiversity. Yet, a large panel of models is today available to address more specific questions, between human drivers and landscape, global incentives and landscape, or landscape and species. All of them are presently coupled or/and compared in order to qualify less ambitious yet relevant processes related to the landscape.

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Back to the roots – how the ecosystem concept can be used as a basis for multiscale modelling

The ecosystem concept, as proposed by Tansley in 1935, is very rich in spite of its simplicity. Although it was subject to many evolutions in its 70-year history, its interest for ecological modelling may not have been fully exploited. For an ecologist, Tansley's ecosystem is the union of a community of living organisms and their physical environment, and constitutes the basic brick of ecology. For a modeller, the ecosystem of the original definition also presents the interest of being (1) recursive (an ecosystem can be made of ecosystems since everything is viewed as ecosystems), (2) scale independent (there is no reference to any time or spatial scale in the definition) , and (3) arbitrary (the ecosystem is an intellectual construct). When enriched with the more recent concepts of complex system and emergence, these properties allow to propose a set of fundamental classes that could be used to model any ecological object at any scale – what computer scientists call an ontology. An analysis of this ontology demonstrates that (1) hierarchical relations between nested ecosystems are far more complex than a « part-of » hierarchy because they depend on at least three different nesting operators, and (2) there is no fully consistent possible representation of an ecosystem, i.e. models of ecosystems will always comprise parts that are not represented at the same abstraction level. The importance of this latter point is discussed with examples from the trophic network literature.

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A generative 3D landscape modelling system for real-time decision making

Realistic visualization of crops, forest, peri/urban, natural scenes raise high interest with the environmental pressure and social demand. Unfortunately, despite the capabilities of the Internet and graphic boards, virtual landscapes and scenes are still restricted to small-scale user communities, with low dynamics, low aestheticism, low respect to biophysical laws.
Web large-scale VR vegetation scenes is a challenging topic, due to the complex geometry and its rendering; and due to the lack of efficient modeling method and dynamics understanding. Moreover, VR must involve close objects easy to interact with and contextual background objects to settle applications.
However, specific solutions exist, and some of them can be used for WebVR display: light weighted static plant models, paged landscape map geometry, procedural vegetation generation on the fly. Reconstructions from photos, mixture of real and synthetic images in augmented reality are also of interest for this topic.
On the study case "the Ecological project of Chinese ChongMing Island", new techniques are shown: Plant billboards and hybrid models, VRML classical scenes of historical farms, and guided maps with 3D web flash panoramic spot views.
Perspectives are finally exposed from new developments: rule based geometry generation Web browsing, fast reconstruction from image models, high-level simulator output, with a background of novel Web approaches: Web-GI, advanced browsers, collaborative visualisation.

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Effect of Canopy Architecture on Carbon and Water Fluxes: A Numerical Experiment

In this study, we used a spatially-explicit ecohydrological model as a framework for a numerical experiment to explore the implication of canopy architecture on the simulated ecophysiological processes in a boreal ecosystem. We constructed two modeling scenarios (CLUMPED and RANDOM) that differed only in the manner in which clumping was parameterized within the model and analyzed the simulated ecophysiological processes. We considered the spatio-temporal distribution of the two main ecohydrological indicators: the gross primary productivity (GPP) and evapotranspiration (ET) under the two scenarios. We hypothesized that canopy clumping can affect the partitioning of light distribution in the canopy and hence the accuracy of the simulated GPP and ET via leaf physiological variability. From the results of this numerical experiment, we concluded that errors in the parameterization of canopy architectural properties had considerable effects on the magnitudes of the simulated ecophysiological processes directly through changes in canopy RT and indirectly through changes in soil water balance-based feedback mechanisms. Hence, it is important to explicitly consider in ecological models because it can govern the partitioning of light inside a canopy.

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Designing and validating agent-based models: two sides of the same coin

Designing and validating agent-based models (ABMs) poses unique challenges because ABMs can be complex. Here I argue that these two challenges are inseparably bound to each other: whether or not we can validate a model depends on its design and, vice versa, model design depends on whether or not we address validation explicitly when formulating a model's purpose. I will present two techniques for dealing with these challenges, ODD and POM. The "ODD" (Overview, Design concepts, Details) protocol is a standard for describing ABMs in publications, but also provides design patterns for the model developer. ODD starts with an overview of what the model is and does, then describes how the model implements ten "design concepts" that capture essential and unique characteristics of ABMs. Last come all the details needed to completely replicate the model. Using ODD for formulating and designing models does not impose constraints on model structure but nevertheless helps organizing models and the modelling process in a way that facilitates testing and validation. "Pattern-oriented modelling" (POM) is a set of strategies for using patterns observed in reality to ensure that an ABM can be validated. POM starts with identifying multiple patterns of behaviour in the real system and its agents that seem to be linked to the essential internal mechanisms for the problem being modelled. These patterns are then used to decide what kinds of entities, state variables, and processes need to be in the model; compare and test alternative "theory" for key agent behaviours; and filter potential parameter values to limit uncertainty. I will provide examples and conclude that using ODD and POM, or similar protocols and strategies, will help us obtaining predictive understanding of how real agent-based complex systems work.

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Study of two forested watersheds in Les Landes region : changes in carbon and water budgets over time and impacts of two consecutive storms

The role of Extreme Climatic Event, ECE, that is to say large disturbances that occur rarely, such as storms, is an extending area of ecological research. The hurricane-associated winds and rains have direct impacts on plant communities structure and indirect consequences on insect and disease dispersal, carbon and water flux and budgets, etc. (Cook, 2008, Lindroth, 2009).
In this study, we present two watersheds (Tagon and Bouron) of Les Landes forest located in the South Western region of France. There are small tributaries to the Leyre river, which flows to the Arcachon Bay. The Bouron watershed (W 00°80'02", N 49°42'31") covers a n area of 48 km². The Tagon watershed (W 1°03'02", N 49° 63'18") extends over 22 km². Elevation ranges from 80 m to 16 m a.s.l. for the Bouron watershed, and from 60 m to 1 m a.s.l. for the Tagon watershed. Slopes are very low: 1% mean for each watershed. Soils are mainly sandy spodosols settled from fluvio-atmogenic deposits, during the Pliocene and the Quaternary with some clay vein and gravel concentration in small areas. These two watersheds are comparable in terms of land cover (close to 90% of coniferous forest); they have been alternatively damaged by the two successive Martin (Dec. 1999) and Klaus (Jan. 2009) winter storms, Tagon being more damaged by the former and Bouron by the latter. The water runoff, forest growth, water table depth and climate of the two watersheds have been monitored since 1980. Groundwater table levels are monitored with 9 and 12 wells for the Bouron and Tagon watersheds, respectively. Runoff at the watershed outlets was measured by the DIREN for over both Bouron and Tagon. However, measurements stopped in 2006 at the Tagon site but a new runoff measurement station was installed by INRA at the end of 2009. Two simple weather stations were installed in both watersheds to provide measurements of temperature and atmospheric pressure (HOBO U20 Data Logger) and rainfall (SPIEA rain gauge). For each watershed, land cover maps, including detailed information of the pine forest's age structure, was obtained from 1984 to 2008 using satellite information, ground truth and statistics of the national inventory.
Our project aims at calibrating and implementing a coupled eco-hydrological approach to disentangle the effects of land cover changes, ECE, climatic changes and forest management on the water and carbon budgets for the last decades over these two forest areas.
Preliminary results of this study are given to illustrate the impact of the two storms of 1999 and 2009 at the scale of the watersheds, in terms of damages in the forest structure, and in terms of the runoff processes over the five years following these large ECE events.

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Land surface phenology as an integrative diagnostic for landscape modelling

Integrative landscape modeling requires integrative diagnostics to enable both model developers and model users to calibrate and validate against trusted reference data and to evaluate the consequences of simulation experiments. My argument is that land surface phenology can serve as such an integrative diagnostic. I begin by reviewing what phenology is in general and land surface phenology in particular. I then discuss how land surface phenology is well-suited to model tuning and simulation experiments. I conclude with an example of modeling future land use change in the Northern Great Plains of North America if large areas of croplands currently in maize/soybean rotation shift to perennial grasses harvested for feedstock to cellulosic ethanol biorefineries.

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Modelling landscape variation in species richness: a multi-scale approach

Species richness is widely used by animal ecologists as a biodiversity metric. Modelling landscape variation in species richness is, however, subject to strong statistical constraints when reliable richness estimates are restricted to few sampling sites. In this study, we assessed the efficacy of some richness surrogates whose computation is based on the relative abundance of relevant species groups. Available from any single sample, abundance estimates are usually adequately modelled as a function of landscape configuration, and as such offer considerable advantages over the direct modelling of species richness. When applied to a complex bat assemblage in a fragmented neotropical rainforest, most candidate surrogates were tightly correlated with observed species richness (r= 0.71 to 0.88). These surrogates can be used as reliable tools to compare the efficiency of different landscape management scenarii or landscape restoration priorities with regard to biodiversity.

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Web based tree and vegetation representation in VR environment applications and studies. An example hold on ChongMing Island

Realistic visualization of crops, forest, peri/urban, natural scenes raise high interest with the environmental pressure and social demand. Unfortunately, despite the capabilities of the Internet and graphic boards, virtual landscapes and scenes are still restricted to small-scale user communities, with low dynamics, low aestheticism, low respect to biophysical laws.
Web large-scale VR vegetation scenes is a challenging topic, due to the complex geometry and its rendering; and due to the lack of efficient modeling method and dynamics understanding. Moreover, VR must involve close objects easy to interact with and contextual background objects to settle applications.
However, specific solutions exist, and some of them can be used for WebVR display: light weighted static plant models, paged landscape map geometry, procedural vegetation generation on the fly. Reconstructions from photos, mixture of real and synthetic images in augmented reality are also of interest for this topic.
On the study case "the Ecological project of Chinese ChongMing Island", new techniques are shown: Plant billboards and hybrid models, VRML classical scenes of historical farms, and guided maps with 3D web flash panoramic spot views.
Perspectives are finally exposed from new developments: rule based geometry generation Web browsing, fast reconstruction from image models, high-level simulator output, with a background of novel Web approaches: Web-GI, advanced browsers, collaborative visualisation.

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Computational modeling for forest dynamics with Markov model individual-centered

Modeling the dynamics of forests is a difficult subject. The forests are in fact ecological systems of great complexity that show interaction phenomena associated with competition between individuals of the same species but also between individuals of different species, (Picard, 2007). This competition is about access to resources (light, water, nutrients ...), It also leads to increases in personal interaction. The scales of forest ecosystems are very long. We can roughly classify the models into two types:
- Models ‘aggregate’ (non-spatialized) where the individual is not taken into account as such but through global variables (number of individuals of trunk diameter in a given class, total volume, total biomass ...). In this case we obtain models of ordinary differential equations (ODE) or stochastic process.
- Spatialized models that take into account the spatial distribution of individuals:
    * Either form of density we obtain models of type partial differential equations (PDE).
    * Or as individual-centered: We obtain models of stochastic branching processes.

It is this very last model that we want to use.
This work does not pretend to offer a faithful model of forest ecological systems, but rather to propose an individual-centered model taking into account two key features:
- Birth: each individual is likely to give birth to a new tree located near to the parent tree.
- Death: the death is due to natural causes or to competition for access to natural resources.

The growth will not be addressed in this work. In this work, we present the simple model that we studied and the numerical simulation tests. The simulations were done in MatLab.

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The development of a conceptual framework to assess multifunctional landscapes and the impact of land use changes on land use functions with “Pimp Your Landscape”

The assessment of land use functions (LUF) has become very important most notably in questions of sustainability and multifunctionality of landscapes. Models often are overparameterised and therefore regularly focusing on small study areas where input data are available. Systems for integrated environmental management often draw emphasize on certain land use types (LUT) (e.g. forestry, agriculture) or special issues (e.g. erosion risk, flood management). The aim of this work is to further enhance the evaluation basis for Pimp Your Landscape. This is an interactive tool for the visualization and evaluation of land use changes. The plan is to develop a holistic indicator-based evaluation approach on landscape level where all LUTs are considered and various LUF can be regarded depending on the planning targets. According to a conceptual aggregation scheme the choice of suitable indicators is in progress. As expected, major constraints and problems are caused by the lack of comparability between e.g. economic parameters of different LUTs as it is depicted in this progress report. Participatory processes and expert knowledge will still be indispensable to adjust results. The beneficial aspect of the presented approach is the comprehensive manner with which we envisage to regard landscapes and their functions. Different LUTs are not considered uncoupled from other land uses but assessed in an integrative way where also structural properties of the study area will be accounted for.

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Time-Space Dependencies in Land-Use Successions at Agricultural Landscape Scales

The agricultural landscape can be seen as an assemblage of farm territories. The way farmers organize these territories is a time AND spatial process. Understanding how a land-use succession (LUS) in a parcel depends on LUS of the neighbouring parcels is a milestone to understand the time-spatial organization of the landscape mosaic. In this work, we analyse these time-space dependencies at agricultural landscape scales. We have performed a data mining process based on hidden Markov models (HMM) to identify spatial clusters of similar distributions of LUS in 2 neighbouring parcels, furthermore called cliques. We applied this data mining process to a land-use data set covering the period from 1996 to 2007 of a 350 km² agricultural landscape located within the Niort Plain (France). To take into account the irregular neighbour system of the parcel mosaic, we used a variable depth Hilbert-Peano scan of the area covering the landscape. Through illustrative examples of two contrasted spatial stochastic clusters, we show that considering temporal cliques gives valuable information on the neighbour system in terms of attraction between LUS.

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From a local problem to design a generic tool for decision making at farming regional scale.

To help decision making in an irrigated area, we have used different tools like GIS, simulators, tools to classify…Confrontation with local actors (farmers and water managers) has shown problems to use these tools in interaction with them. Furthermore, they have underlying needs during collective meetings to (i) quickly modify data used in models (ii) include new classifications and new management rules to define with stakeholders interpretable, questionable and modifiable scenarios. In this perspective, we have developed and tested a simulation tool called 3Sys where we have the main functions simplified from GIS, simulators, classificators and multi-agent systems. The participation of different actors has shown model relevance and possibilities to validate different types of data and rules used. The integration of concepts from different approaches already used in the same tool seems to increase and help the actor’s participation, as well as local stakeholders than scientist from different disciplines.

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Modelling neutral agricultural landscapes with tessellation methods : the GenExP-LandSiTes software - Application to simulation of gene flow

We present a three steps approach that aimed at simulating neutral agricultural landscape models: (1) we characterized the geometry of three real field patterns; (2) we generated simulated field patterns with two tessellation methods attempting to control the value of some of the observed characteristics and, (3) we evaluated the simulated field patterns. The first two steps were integrated to the GenExP-LandSiTes software that thus simulates two-dimensional agricultural landscapes. It is written in Java, and it is freely accessible through a Gnu Public Licence. For the third step, we considered that good simulated field patterns should capture characteristics of real landscapes that are important for the targeted agro-ecological process. Real landscapes and landscapes simulated using either a Voronoi or a rectangular tessellation were thus compared when used as input data within The MAPOD-maize gene flow model. The results showed that the Voronoi tessellation performed better than the rectangular tessellation. In our ongoing research we consider random line-based tessellations constrained by a probability distribution penalizing the extreme values of targeted features (for example too large variability of cell areas). We also propose an algorithm for simulating such tessellations. The probability distribution parameters can be fitted from observed landscapes. This should result in generating tessellations similar to real patterns.

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Bottom-up approach of landscape simulation leading to a generic synchronization formalism and competition model

Our study of "functional landscapes" stemmed from several factors. The first was the maturity of the GreenLab model for uniform stands that left open the question of heterogeneity. The second was the realisation that most of the applications are at the landscape scale, and ask us to be able to simulate the interaction of our plant model with other environmental models. Given our background and objectives, our main focus remained on the plants inside the landscape, with the intent to keep modelisation work on the rest of the landscape's components to a minimum. We adopted a bottom-up approach, starting with what we knew how to do and expanding according to where our experiments showed potential improvements. The first prototypes had severe shortcomings in software architecture and led us to consider a new simulation formalism for our needs, as well as a new model for competition on resources.
The synchronisation formalism and software architecture is a lot more flexible and generic than what we had originally, but at the same time it lays some drastic constraints on the models themselves and their capacities. It can be seen as a drawback, but we consider this to be a great modelisation tool: it forces the modeler to be perfectly clear about the assumptions of the model, specifically about the time behaviour. The reimplementation of the plant model in this architecture highlighted some interesting points that could bring advances in the modelisation of single plants.

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Spatial and temporal variability of the carbon budget of tropical eucalyptus plantations assessed using ecosystem modelling and remote-sensing

The role of managed forests will be essential in addressing the challenges of climate change mitigation by adaptive forest management and enhancement of carbon sinks. The first step is the quantification of forest carbon budget at large scales, which is an issue at the center of forest landscape ecology. In the aim of estimating regional-scale carbon budgets of Eucalyptus plantations in south-eastern Brazil, the G'Day ecosystem model was combined with remotely-sensed estimates of leaf area index. The spatialization potential of G'Day was assessed through simulations on 16 stands, which encompassed a large range of age and fertility levels. In parallel, the leaf area index (LAI), a key model variable, was obtained for the 16 sites by inversions of MODIS remotely-sensed reflectance time series. These inversions involved the coupling of a hybrid-type canopy radiative transfer model with a soil reflectance model and a leaf reflectance and transmittance model. The inverted LAI was highly seasonally and interannually variable. The inverted LAI is used as a forcing variable of G'Day. Results show that the G'Day model is efficient at simulating stand biomass over a wide range of values. The stem biomass increments are also fairly well simulated at different ages, and improved when we use the inverted LAI. A limitation is that inter-stand variability in biomass increment is not well reproduced for the oldest stands. We will discuss the implications of our work for the carbon budget monitoring of Eucalyptus plantations at large scales.

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Participatory design and use of an agent-based model for mitigating land use conflict in Northern Thailand highlands

In the remote highland forest-farmland ecosystem of Doi Tiew, a Hmong village in Tha Wang Pha District of Nan province, a land use conflict is taking place between the local herders and two government agencies (the new Nanthaburi National Park -NNP- and the Nam Khang headwater research and development unit -NKU) having different interests, objectives and perceptions on land use. While local herders strive to continue extensive cattle raising in forest, fallows and reforestation plots, the NNP would like to exclude human activities from the park and the NKU is involved in the reforestation of this upper catchment. A computer assisted role playing game was used during the first stage of this research to stimulate exchanges among the different stakeholders and to give them the opportunity to become familiar and to validate a first version of a conceptual model. Later on, an agent-based model has been developed to provide the possibility to explore some management scenarios related to new techniques proposed during the debriefing of the role-playing game sessions. In this paper, the structure of the ABM will be described, the simulated scenarios will be compared and the way they were used to support discussions among the stakeholders represented in the model is finally presented.

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Landscape level carbon and water balances and agricultural production in mountainous terrain of the Haean Basin, South Korea

The process-based spatial simulation model PIXGRO is being developed to estimate gross primary production, ecosystem respiration, net ecosystem CO2 exchange and water use by forest and crop fields of Haean Basin, South Korea at landscape scale. Simulations are run for individual years from early spring to late fall, providing estimates for dryland crops and rice paddies with respect to carbon gain, biomass and leaf area development, allocation of photoproducts to the belowground ecosystem compartment, and harvest yields. In the case of deciduous oak forests, gas exchange is estimated, but spatial simulation of growth over the single annual cycles is not included. Spatial parameterization of the model is derived for forest LAI based on remote sensing, for forest and cropland fluxes via eddy covariance and chamber studies, for soil characteristics by generalization from spatial surveys, for climate drivers by generalizing observations at ca. 20 monitoring stations distributed throughout the basin and along the elevation gradient from 500 to 1000 m, and for incident radiation via modelling of radiation components in complex terrain. Validation of the model is being carried out at point scale based on comparison of model output at selected locations with observations of LAI, biomass, fluxes and crop yield, as well as with known trends in ecosystem response documented in the literature and regional statistical data. The resulting modelling tool is useful for estimation of ecosystem services at landscape scale, first expressed as kg ha-1 crop yield, but via future cooperative studies also in terms of monetary gain to individual farms and farming cooperatives applying particular management strategies.

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Towards landscape modelling of marine reserves

Most of the questions and methods used in landscape ecology for terrestrial ecosystems are also relevant for marine ecosystems. For example, there is a large body of literature on landscape connectivity in terrestrial systems (recently reviewed by Kindlmann and Burel, 2008), which has many natural parallels with fragmented marine systems like coral reef ecosystems. A landscape is composed of suitable habitats and a non suitable matrix that connects them. In a coral reef system habitats are reefs and the matrix is the water and sandy habitats not suitable for settlement. The distinction between structural and functional landscape connectivity is also essential for reef systems: the spatial distribution of reefs and water movements determine the structural connectivity, while the behaviour of organisms (within the matrix) contribute to the functional connectivity. Despite these parallels between terrestrial and marine ecosystems, there are only a limited number of studies where the concepts of landscape ecology are applied to marine ecosystems (Hinchey et al. 2007). Marine reserves are a promising tool for the management of marine ecosystem's goods and services. Prevailing methods for designing marine reserves networks remain strictly habitat based (e.g., Airame et al. 2003) and do not take into account concepts such as population connectivity that are central to landscape ecology. A number of authors have recently developed spatial metapopulation models of marine reserves networks (e.g., Walter et al. 2007; Kaplan et al. 2009). The major limitation to using more sophisticated modelling approaches is the considerable uncertainty surrounding larval dispersal patterns (Shanks et al. 2003). New methods and tools for measuring (e.g., Jones et al. 2005) and simulating (e.g., Lett et al. 2008) larval dispersal are now available. The challenge that remains is to integrate these methods into metapopulation models
(Levin 2006; Jones et al. 2009).
In this talk, we will first elaborate on the links between landscape ecology, marine ecosystems and marine reserves. We will then show how improvements in our ability to assess larval dispersal will allow us to integrate modelling of marine reserves into the wider field of landscape modelling.

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Sediment generation and sediment management for the Federal District of Brasilia, Brazil

Sedimentation (silting) is a major problem in reservoirs of the Federal District of Brasilia and has already resulted in the loss of smaller drinking water reservoirs. The focus of this study is on the process of sediment generation/transport and measures to prevent or minimize sediment generation and input in reservoirs.
In a first step we will focus on modeling soil erosion and effects of soil management and anti-erosion measures using the model WEPP. The data base is good for precipitation, soil properties and management, but measurements on sediment yield do not exist. Therefore, we are going simulate the effect of anti-erosion measurements only for typical combinations of soil management, crop rotation, and soil properties.
A second approach for sediment generation in urban catchments will focus on measurements of sediment yield. This might provide the empirical base for a conceptual model for understanding the processes of sediment generation in urban areas. We assume that urban structure, construction sites and shares of bare soils are key parameters for sediment yield.
We will use the web-based planning tool letsmap to support decision and participation in land use focusing on sediment generation. The basic idea of the tool is a cell automat that considers land use and its effect on sediment generation, the geographical position to rivers, erodibility and economic effects.
The overall target is a sediment management plan that reduces the sediment input into reservoirs due to a twofold approach, (i) for slopes the focus is on minimizing sediment generation and (ii) for alluvial systems the retention of sediments has to be maximized.

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Toward the simulation of the Amazon-influenced mangrove-fringed coasts dynamics using Ocelet

Efforts to describe the functioning and the dynamics of the 1600-km-long mangrove-fringed coast of the Guianas, a giant ocean-mud-mangrove interface, depict a highly complex system where sedimentary, ecological, morphodynamic, biogeochemical and oceanographic processes are closely linked at all spatial and temporal scales. To our knowledge, no model is presently capable of simulating multi-scale influences of coastal physical processes on mangrove development. Existing models are relatively few and are disconnected. In this paper we explore an approach based on a landscape modelling language called Ocelet. After a brief description of the modelling approach and its simulation environment, we explain how we would decompose the complex mangrove dynamics modelling problem into more accessible parts. One of the parts focusing on mangrove expansion on a mud bank is detailed, and the incremental enrichment of the model with other coastal interactions between vegetation, mud and ocean is discussed.

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A landscape approach to sustainable forest management and habitat quality modelling

This work provides views and examples on how the holistic approach of landscape ecology can be considered towards the interplay between biodiversity value and the needs of forestry activities. Focusing on biodiversity conservation as a proxy for ecological dimensions of sustainable forest management the work proposes a series of requirements for the conservation of habitat networks and ecological processes to be met by forest landscape managers. This is particularly challenging nowadays because of the increasing pressures to intensify wood production and timber exploitation. Nevertheless, there are also demands for improving the actions in favour of safeguarding biodiversity, and in a more general way improving forest ecosystems functioning. This twofold requirement of an optimized forest production and an environmental quality improvement represents a true challenge for the years to come. A fast reorganization of the system is needed in order to find the right balance between management within a forest ecosystem services approach at different scales. In particular, we need to consider a valorisation of wood resources and production, thorough knowledge of their vulnerability within an intensification management scenario.

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Trade-off analysis of land use change, livelihoods and environmental services in the upper Konto catchment (Indonesia): prospecting land use options with the FALLOW model

Throughout the world, conversion of natural forest, agricultural intensification and tree planting have environmental, economic and social impacts. Growing populations and market-based development accelerate changes in parts of the developing world. In areas where new land is no longer available and accessible, intensification may lead to conflicts. Trade-off analysis on the impact of land use change on livelihood and environmental services can help through evaluation of current land use and future management options. If scenario analysis is based on a credible landscape simulation model, we can assess various land use options and its consequences for livelihoods carbon stocks and water flows, with various incentives and rules to enhance environmental service provisioning. This paper evaluates, against data of actual patterns of change, the use of the FALLOW model (van Noordwijk, 2002; Suyamto, 2009) in assessing the trade-offs involved in land use change in the Upper Konto Catchment of East Java, Indonesia. The FALLOW model is a spatially explicit model (http://www.worldagroforestry.org/af2/fallow) that integrates understanding of landscape mosaic and resources interactions. In addition to land use system profitability, the FALLOW model includes farmers' learning dynamics as a factor that influencing farmers' land use choices at plot level, hence affecting soil fertility, food security and above-ground carbon stocks.

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Modelling forest fire risk change related to land cover change: an integrative approach

Forest fire risk evolves due to land cover change. Several processes are involved like forest extension on former agricultural land and discontinuous urbanisation process. The dynamic of the risk represent the interaction between this vulnerable zones land cover change and fuel zones (forest) spatial dynamic. In order to manage the risk through land planning, decision makers need simulation tools able to preview spatial evolution of risk levels.
To simulate the dynamic of the risk we chose an integrative way, consisting in integrating simulators specialised in either fuel land cover spatial dynamic (forest) or vulnerable land cover dynamic. While existing simulators of forest land dynamic were used, like Afforsim (Prevosto & al., 2003) at micro-local scale (patch) and Landis II (Scheller & al. 2006) at macro-local scale (landscape), two spatial dynamic models specialised in discontinuous urbanisation process and complex areas dynamic representation, Micropolis at micro-local scale, and Macropolis were specified and implemented into simulators. Micropolis is a Multi-Agents Based system where interact social agents and spatial agents. Macropolis is a cellular automata developed on a raster geoghaphical information system environment.
Then, a specific integration platform called Pyroxene was developed. Pyroxene is also a multi-agents system specialised in spatio-dynamic models and simulators integration. It is organised in an architecture inspired form HLA (High Level Architecture), and is partly compliant with the FIPA (Foundation for Intelligent Physical Agents) specification. It allows executing specified models for model integration on geographical system, in order to ensure semantic interoperability of the different models.

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Integrated land use modelling in an interdisciplinary project: The LUCIA framework

The Land Use Change Impact Assessment tool LUCIA was designed to address processes at landscape scale in mountainous catchments of Northern Thailand and Vietnam. As part of an interdisciplinary research program, the biophysical model integrates hydrological, edaphic and plant-related aspects and can be dynamically coupled to a multi agent model that simulates decision-making based on socioeconomic criteria. Research questions in the given context embrace agricultural intensification and reduction of fallow periods in the upland areas. These changes influence ecosystem functions and productivity particularly in the lowlands through run-off, erosion, siltation and translocation of nutrients. The socio-economic component is relevant as land use change depends on farmer decisions, which are often market-driven. While many models are available that can simulate single components of the system in a more detailed manner, LUCIA aims at integrating the most important biophysical factors related to land use change. The entire model can be operated by users of any of the involved disciplines as well as by advanced stakeholders. Such an integrative approach requires a modelling framework that allows both mechanistically capturing the most relevant processes and at the same time minimising parameterisation efforts and run time. Thus, criteria in model development were transparency, modularity and user-friendliness. Apart from the option to (de)couple modules, the framework was conceived.

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Integrative simulation of agricultural and landscape changes

Patterns and functions of European landscapes should be strongly modified by the changes of agricultural activities and by the way they will react to the new European agricultural policies after 2013 and the CAP redefinition.
In that context, models of interactions between agricultural practices and ecological dynamics are of great relevance for considering the potential changes in landscape structures. In previous research actions, our team developed scenarios of landscape and policy change, as well as simulations of landscape change . At that stage, we wanted to develop a more integrative and participatory approach for simulating landscape ecological dynamics and farms socio economic changes in order to allow stakeholders to build their own scenarios according to their identified needs. The first objective of this communication is to explain why our models have properties that make them simulators adapted to participatory approaches for scenario building. The cellular automaton Genevrier simulates the evolution of land cover. All transition rules can be displayed and modified by stakeholders during working sessions. The socio-economic simulator Larzac, allows simulating the consequences on farm income of scenarios defined with stakeholders and based on information describing the farming system.
The second objective is to present the potentialities of using both simulators as complementary tools for considering alternative agro-environmental policies.

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Optimization of rural land health: integrating multiple functions

The MULBO (Multi-criteria Landscape Assessment and Optimisation) framework has been specifically developed to help guide these complex multiple objective decisions. In this current project MULBO has been trialled in the Lake Tyrrell Basin of Northern Victoria, Australia. Lake Tyrrell is situated within the Mallee region and covers an area of around 400,000 hectares. The Mallee is a semi-arid region which supports broad-scale cropping on sandy low nutrient soils, where traditional agriculture has had a high impact on native fauna and flora, and where naturally saline groundwater and wind erosion present significant threats to both agricultural production and biodiversity. The MULBO process includes the following steps (a) goal determination across multiple management criteria, (b) function analysis on the basis of GIS, (c) function assessment, (d) scenario formulation and (e) land use compromise optimisation to calculate land use scenarios .
In this project, major land management goals within the Mallee were identified on the basis of regional and local management objectives and input from regional land managers, representatives from community environmental programs and farmers. Major landscape health problems in the region were identified, as were the major management objectives to be optimized. These objectives included indicators for (a) farm income, (b) salinity risks, (b) wind erosion and (d) habitat connectivity.

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Trade-offs between livelihoods and wetland ecosystem services: lessons from an integrated dynamic model of Ga-Mampa wetland, South Africa

The Ga-Mampa wetland in the Limpopo river basin (South Africa) provides several provisioning services which support the livelihoods of communities living around the wetland. Between 1996 and 2004, fifty percent of the wetland was converted to crop production. Although wetland agriculture brings significant benefits to the wetland communities in terms of food security and income, continued conversion of the wetland for agricultural purposes may undermine the ecological integrity of the wetland, reducing the wetland's capacity to continue delivering ecosystem services in future. This paper presents an integrated dynamic simulation model that represents the interactions between the wetland bio-physical functioning and the local community using it. This model is used for analyzing trade-offs when wetland resource use choices are made.
The model developed using the STELLA® platform, comprises six interactive modules (model sectors) namely: hydrology, crop production, non-agricultural wetland resources, land use, community well-being (a 6th sector allows to control annual and seasonal cycles).
Several scenarios of management interventions, other livelihood activities and external context were simulated to assess the trade-offs among the various ecosystem services provided by the wetland.

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Assessing of the impact of man-made structures on the hydrological behaviour of farmed catchments by distributed hydrological modelling

Management of water resources of agricultural catchments has emerged as an environmental priority due to the effects of anthropogenic discontinuities or activities such as the field limits, embankments, drains, ditches, and agricultural practices on runoff, erosion and pollutant transport. MHYDAS, a physically based distributed hydrological model, was especially developed to model water, pollutant and erosion transport, taking into account these discontinuities and practices. A modular approach was undertaken using the platform OpenFLUID, which enables the user to build his own version of MHYDAS by combining various processes (interception, runoff, channel routing, infiltration, transfer in the soil, pollutant fate and transfer, erosion transfer) as a function of the objective of the study and the availability and the accuracy of the data. Application cases are shown and compared in various agro-hydro-climatic conditions in order to study the impact on water and pollutant transfer of tillage practices in the vineyard, stemflow in tropical volcanic zone and drains in drained catchments. Finally, the model was applied to simulate the impact of various landuse scenarios.

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Representing economic mechanisms in agent-based models of socio-ecological systems: how far have we come?

In the last ten years, tremendous progress has been made in the development of spatially explicit, coupled models of socio-ecological systems. Due to the highly interdisciplinary nature of such models, it has been a major challenge to identify and incorporate key processes from relevant disciplines, especially since scholars from the many disciplines involved have often found themselves working in an interdisciplinary context for the first time in their careers. Due to the need to keep already complex models as simple as possible, there has been a need to come up with minimal representations of relevant processes on the social and ecological sides of the models.

Yet, this need for parsimony, combined with the composition of many interdisciplinary teams, and the very significant challenges of acquiring relevant socioeconomic data, has often meant that economic drivers and processes have been excluded from spatial agent-based models of socio-ecological systems (SABM-SES). In this talk, I make a case for the importance of including key economic processes (market and non-market) in SABM-SES by reviewing the real-life roles that such processes play in coupled-human and natural systems. I then review some examples of coupled models that successfully include economic processes, including several models of land market dynamics to which I am a contributing scientist. I conclude with a set of open questions and challenges.

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Graphic stage setting: a mediation tool for integrative environmental approaches

Many scientific approaches propose a graphic module either to display results (for example, classical statistical tools like plots, histograms, mapping…), or to facilitate the analysis of a complex issue (for instance, how does light impact tree growth dynamic depending on its 3D architecture?) or to support the coordination amongst stakeholders (example: how does a graphic mock-up help the users to estimate the consequences of an action onto the system?). Furthermore, the graphical interface can play an even more important and integrative role, as giving a list of constraints imposed by one approach onto the others, as an interactive collaborative decision tool, as a synthesis of current knowledge and finally as on ontology, qualifying the elements of the area depending on the specific experience of the stakeholders involved.
In this context, the graphic designer has a particular place in the project: he has to propose a credible image to facilitate the expression of the various viewpoints, he has to simplify the model in order to allow interactivity and real-time reaction and he has to render the system visible and readable by adjusting the level of realism or abstraction, according to the end-user, but always being technically and scientifically sound.
As an illustration, we present a game under construction, VirtualVitis, designed to capture the practices developed by the wine producers in relation to the determinist models known in the areas implied.

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Exploring different forest landscape scenarios in Papua

This paper reports on combining the system dynamics software STELLA with the spatial simulation software GEOMOD (IDRISI) in order to visualize simulated forest cover changes produced by STELLA on maps. A socio-ecological model has been built in STELLA for Kaimana district including spatial and many non-spatial components. The model is built in a participatory manner with district officials and non-governmental organization personnel. We used it to explore environmental and social impacts of large scale plantation investments or payments for Reducing Emissions from Deforestation and Forest Degradation (REDD). We focused on the socio-economic consequences district level decisions would have for local livelihoods. The simulated outcomes are fed into a strategic discussion aiming to better inform the decision making process in Kaimana. We report on advantages and shortcomings of combining the two simulation programs and give an overview of the conservation and development landscape outcomes under each of the scenarios explored for the Kaimana district.

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Evaluating global change influences on ecosystem services in agricultural production versus water yield and water quality in mountain landscapes

As a case study where management based on social-ecological principles should lead to sustainable supply of ecosystem services, the international project TERRECO (Complex Terrain and Ecological Heterogeneity) applies a transdisciplinary modelling approach to examine current and potential future natural resource use within the largest reservoir system of South Korea, Soyang Lake Watershed. Due to intensive fertilization, small catchments within the watershed export some of the world's highest levels for N and P, while steep terrain and monsoon rains result in extremely high material transport. To consider future management with climate change at regional scale, new integrated modelling approaches are being developed for land surface processes and production, for hydrology and transport, for economic evaluation of ecosystem services, and for associated management and decision-making. The models are supported by ground-based studies of ecosystem physiology and agricultural yield, of soil properties and erosion, of stream flows and transport, of groundwater exchange, of farm economic balances, of statistical data bases, and of individuals preferences in decision-making within particular regulatory and economic frameworks. Scenario evaluations are planned in partnership with provincial and national agencies that currently carry out land use planning and advise on policy making. A common interest among project participants and agency planners focuses on scenarios examining sustainability of ecosystem services. The required transdisciplinary integration for assess-ments of alternative futures, drives the development of modelling systems that apply at landscape to regional scales, couple to specific conceptual goals, and should provide for communication on uncertainties with managers and stakeholders.

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Modelling the interactions between land management and landscape processes

Land change and more subtle land management change can have severe impact on active landscape processes. Well known examples are deforested areas becoming severely susceptible for land sliding and erosion during intensive rainfall invents. On the other hand do land managers take landscape processes into account when making decisions on land use management. This interaction of decision making and landscape processes dynamics can lead to specific spatial patterns of land use/cover.
Spatial-temporal explicit modeling of landscape process dynamics such as water and soil redistribution tillage and mass movements within a landscape, give insight in the performance of agronomic systems within a dynamic landscape context. Interactions between land management and landscape processes are evaluated with a spatially explicit modeling framework (LAPSUS). Only after a spatially explicit multi-scale system analysis and explorative landscape process modeling scenarios, can more sustainable landscape use plans be designed.

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Modelling the influence of land use and land cover change on landscape functions

One of the main challenges in monitoring, modeling and communicating land change is the relation between land cover, land use and the provision of goods and services by the land system. A change in the provision of goods and services by the land is often not just a result of land cover change but an important driving factor of future land cover dynamics as well. Assessments of the change in landscape functions are difficult because there is no one-to-one relation between land cover and functionality. Functionality is often determined by both local and contextual factors synchronously. In addition, landscape function may not be observed and monitored by standard techniques used in land cover observation. In many cases landscape function may drastically change without any change in land cover and vice versa. This presentation aims at providing an overview of the state of the art in methods and models for assessing land use and land cover change in relation to landscape functions. These methods include:
-top-down, spatially explicit land change models
-agent-based simulations of local decision making leading to changes in landscape structure
-methods to map and model landscape function response to policy and planning at the regional scale
Based on this overview a number of promising pathways of further developing land change models that better account for the multiple functions of the land will be discussed.

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Model Integration in Socio-Environmental Modeling: Participatory, Multidisciplinary, Community, and other Kinds of Modeling

The global crisis that we are facing may require a different approach to environmental and ecological modeling. As we find ourselves under increasing pressure from climate change and peak oil, science may need to reconsider its priorities from pure to more applied and society driven research. Drawing from the 25 years of modeling done for the Chesapeake Bay area, as well as from other applications, I will briefly review some of the more prevailing modeling types and techniques, giving a somewhat biased critique of their strengths and weaknesses in the context of global change. I will argue that there is a huge disconnect between what we already know and what is actually used for decision making. We may need to reconsider our reliance on software and computerized systems as a way to solve complex environmental problems, and invest more into tools, frameworks and procedures that help communicate knowledge. Community efforts in close participatory collaboration with stakeholders offer a promise of efficient decision making. The euphoria about integrated transdisciplinary models built from prefabricated blocks as in a Lego constructor might be short-sighted if we bring into account the problems of scale, resolution and interoperability. More simple models developed with stakeholder participation may have a better chance to be used and help in consensus building and conflict resolution. It is unlikely that technology will pull us out of this crisis, but human adaptations and behavioral shifts - certainly can.

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Modelling water, energy and associated mass fluxes in managed landscapes: current issues and gaps.

Ecosystems or landscapes are not just mere collections of objects or bodies that coexist in nature: they are spatially organized with internal entities or units that interact. Hence, simulating the behaviour of ecosystems and landscapes requires one to model not only the individual behaviour of their constituting elements but also their interactions. One main source of interaction in a landscape is the exchange of mass and energy between its elements. However, our ability to simulate fluxes accurately in natural or managed landscapes still remains very limited, and the development of integrative landscape modelling remains one major challenge. In this talk we review the needs and present gaps in modelling fluxes in landscapes. Firstly the main types of fluxes of interest for present and forthcoming landscape management issues are presented. Then the main landscape characteristics and heterogeneities that should be considered in modelling, given their potential impact on landscape fluxes, are discussed. Finally the review attempts to point out the major limits, gaps and also recent success in modelling energy and mass fluxes in the air and in surface- and ground-waters.

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An Integrated Stock-flow and Agent-based Model for Simulating Land Use and Environmental Change in Peri-urban Area

Peri-urbanization is not only triggered by socio-economic development but also result from interactions between humans and their environment. An integrated model that links a stock-flow model with an agent-based model can enhance our understanding of the interactions among land use, human decision-making, and environmental change. In this paper, we provide an illustration of a joint application of stock-flow and agent-based modelling to simulate land cover change from agricultural landscape to an urbanized system via the integration of biophysical approach and decision making bodies of land cover change. Therefore, a case study is used to demonstrate the change patterns of agricultural land and urban land. The major stocks and flows and their interactions can be represented in the conceptual energy diagram. The rate of urban asset accumulation determines the amount of areas which should be converted to urban built-up lands. Three main agents of the study area have been chosen and their action rules are used to allocate land use activities on the most suitable places which can reveal the results of decision making. Results indicate that the dynamic changes of the peri-urbanization in the study region arise from lands adjacent to built-up lands or along the roads where are easily accessible to plain agricultural lands with flat topography. Three scenarios and the implications of simulation results are also discussed in this paper.

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Fuzzy cognitive mapping a tool for integrated modeling and social-ecological research: six European case studies

This paper presents the results of six European case studies conducted in the frame of ALTER-Net, which all employed fuzzy cognitive mapping in the context of analysing driving forces and impact of regional environmental change. Fuzzy cognitive mapping (FCM) is a relatively new method in the field of environmental modelling. The approach, as used in the case studies, offers both: a procedure to involve stakeholders in a research or management processes and a method to extract, depict and analyse different kinds of knowledge about complex systems and their functioning. We used FCM to arrive at stakeholder generated dynamical models of the regions. These models are semi-quantitative in nature which means that they provide information on trends but not on quantitative changes of variables. Comparing the outputs of one of the regional FCM-models to an agent based model of the same region showed a high overlap in the predicted trends.
