

ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

2010

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Foreword

This thematic brochure dedicated to the Environment and Sustainable Development is more than just an update of the previous 2006 edition. It reports on the activities of laboratories and research teams of the Académie Louvain, which groups together three institutions, the FUCaM, FUNDP, FUSL and UCL. Nearly hundred research topics tackled by a large number of laboratories are described.

The large range of areas of expertise and research fields highlights the multidisciplinary and dynamism of the research teams conducting studies in these fields, which are important to our societies. The competences have been divided up into several sections, as follows:

- ▶ The concept of sustainable development;
- ▶ Conservation of resources and biodiversity;
- ▶ Climate change and carbon management;
- ▶ Sustainable mobility and land planning;
- ▶ Sustainable agriculture and food security;
- ▶ Sustainable production and consumption;
- ▶ Human health and the environment;
- ▶ Solidarity and social justice;
- ▶ TICs and sustainable development;
- ▶ Social responsibility of corporations and institutions;
- ▶ Law and policy for a sustainable development.

This brochure is expected to favour sustainable development oriented collaborations between the Academie laboratories and other institutions, be they public or private, including NGOs.

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For any of those reading notes that are associated to a secondary category, the pivot table shows in what category they are. Those reading notes that only cover one topic are listed in the column entitled “none”.

Main topic (1/reading note) and secondary topics (max. 2/reading note)

Principal category	Secondary category												
	Concept of sustainable development	Conservation of resources and biodiversity	Climate change and carbon management	Sustainable mobility and land planning	Sustainable agriculture and food security	Sustainable production and consumption	Human health and the environment	Solidarity and social justice	Globalization*	TICs and sustainable development	Social responsibility of corporations and institutions	Law and policy for a sustainable development	None
Concept of sustainable development					A7	A6	A6	A1, A5	A1, A4		A3, A4		A2
Conservation of resources and biodiversity			B9, B20, B25, B26		B7, B16	B6, B11, B14, B23, B28	B5, B10, B14, B16, B22, B28		B7, B10		B2, B3, B10	B2, B4, B12, B13, B15	B1, B8, B17, B18, B19, B21, B24, B27
Climate change and carbon management		C7		C1, C8								C1, C2, C4	C3, C5, C6
Sustainable mobility and land planning		D3, D8			D3	D1	D4	D4, D7, D8	D9	D7			D2, D5, D6, D10
Sustainable agriculture and food security						E3, E4		E1, E2, E3				E2	
Sustainable production and consumption		F11	F4, F11, F15				F13, F16				F2, F3		F1, F5, F6, F7, F8, F9, F10, F12, F14
Human health and the environment						G4					G5	G3	G1, G2
Solidarity and social justice		H1					H5		H2, H4, H5		H5	H2	H3
TICs and sustainable development				I2		I1							
Social responsibility of corporations and institutions					J1	J1							J2, J3
Law and policy for a sustainable development	K3, K9	K5	K7	K4	K8	K7	K6, K8	K3	K2, K5		K2, K9		K1

* There is no main section “globalization”. Some records have been classified under “globalization” but only as a subclassification.

Redefining prosperity: Multidisciplinary Approach

SENIOR SCIENTIST:

► Isabelle CASSIERS

Research Field and Subjects

For many decades our societies have pursued the objectives of economic growth and material progress. These objectives were partly met in that one can today expect a longer life, higher incomes, more leisure time, etc. On the other hand, adverse effects have also been generated, the consequences of which one today has to pay for dearly. Environmental problems, affected quality of living in some respect and the rise of inequalities are some of the numerous reasons why economic growth does not – or does not any longer – positively impact on life satisfaction. A good understanding of these issues goes far beyond the scope of economics. With a view to feeding and enriching the economists' approach, the research team is intrinsically multidisciplinary: philosophers, sociologists, lawyers, medical specialists, agronomists and engineers' points of view are taken into account.

Representative References

- I. CASSIERS, C. DELAIN. *La croissance ne fait pas le bonheur : les économistes le savent-ils ? (en collaboration avec Catherine Delain)*. Problèmes économiques, n° 2.938, 2 janvier, pp. 3-10. (Repris de Regards économiques, n°38, **mars 2006**).
- I. CASSIERS. Diverses interventions in *Beyond GDP, Measuring progress, true wealth, and the well-being of nations* Conference Proceedings, Luxembourg, Office for Official Publications of the European Communities, Expert invité, interventions reprises pp. 15-97-180-181-191-193, **19-20 novembre 2007**.
- I. CASSIERS. *Pour changer de cap, dégrifions la boussole*. Revue nouvelle, n° 3, pp. 53-61, **mars 2009**.
- I. CASSIERS. *Sortie de crise : relance ou changement de cap ?* Louvain, bimestriel de l'UCL, n° 179, pp. 35-36, **juin-juillet 2009**.
- I. CASSIERS. *Sortie de crise : relance ou changement de cap ?* in *La crise économique et financière de 2008-2009 : L'entrée dans le 21e siècle ?* Textes réunis par Y. DE CORDT, V. DUJARDIN, R. COSTA, V. DE MORIAMÉ. Ed. Peter Lang, Bruxelles, à paraître.
- I. CASSIERS, G. THIRY. *Au-delà du PIB : réconcilier ce qui compte et ce que l'on compte* (en collaboration avec Géraldine Thiry). Regards économiques, à paraître.

Partnership

► ULB

Products and Services

► Training sessions

KEY WORDS

Prosperity
Redefining Progress
Rethinking Growth
De-growth

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Redefining prosperity: GDP and Beyond

SENIOR SCIENTIST:

▶ Isabelle CASSIERS

Research Field and Subjects

Focus is on alternative indicators to GDP. Over the last sixty years GDP has been used as the major yardstick in terms of assessing the economic performance of a nation and leading economic policies. However, it seems more and more obvious that this statistical tool today is no longer accurate enough to tackle the major issues of the 21st century. Finding a substitute for GDP implies thinking about the underlying progress concept(s), adjusting the national accounting system and opening a socio-political debate likely to lead to a new consensus. Clarifying this debate should contribute to moving it forward.

Representative References

- ▶ I. CASSIERS, C. DELAIN. *La croissance ne fait pas le bonheur : les économistes le savent-ils ? (en collaboration avec Catherine Delain)*. Problèmes économiques, n° 2.938, 2 janvier, pp. 3-10. (Repris de Regards économiques, n°38, **mars 2006**.)
- ▶ I. CASSIERS. *Pour changer de cap, dégripons la boussole*. Revue nouvelle, n°3, pp. 53-61, **mars 2009**.
- ▶ I. CASSIERS. *Sortie de crise : relance ou changement de cap ?* Louvain, bimestriel de l'UCL, n°179, pp. 35-36, **juin-juillet 2009**.
- ▶ I. CASSIERS, *Beyond GDP, Measuring progress, true wealth, and the well-being of nations*, 19-20 november 2007, Conference Proceedings, Luxembourg, Office for Official Publications of the European Communities, interventions reprises pp. 15-97-180-181-191- l'UCL, n°179, pp. 35-36, **juin-juillet 2009**.
- ▶ I. CASSIERS, *Beyond GDP, Measuring progress, true wealth, and the well-being of nations*, Conference Proceedings, Luxembourg, Office for Official Publications of the European Communities, pp. 15-97-180-181-191-193, **19-20 novembre 2007**.

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- ▶ I. CASSIERS, G. THIRY. *Au-delà du PIB : réconcilier ce qui compte et ce que l'on compte* (en collaboration avec Géraldine Thiry). Regards économiques, à paraître.
- ▶ I. CASSIERS. *Redéfinir la prospérité*. Direction d'un ouvrage collectif interdisciplinaire. En préparation.

Products and Services

- ▶ Training sessions

KEY WORDS

GDP
Beyond Indicators
Alternative Progress
Measuring

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Sustainability.

Demographic, technological and normative aspects

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- ▶ Axel GOSSERIES

Research Field and Subjects

Topics to be investigated include specific issues relevant to intergenerational justice, sustainability criteria and Pontryagin optimality, optimal population size, population composition and dynamics, population policy, the problem of short-termism, the choice by firms of sustainable technology.

Methods used include philosophical argumentation and social choice theory, general equilibrium theory, dynamical analysis, and quantitative economic theory.

Objectives are: (1) to provide a critical approach to existing sustainability criteria and propose new concepts, (2) to improve our knowledge of the link between population, population composition and long term outcomes, and (3) to shed a new light on the link between firms' policy and (non-) sustainability.

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- ▶ D. DE LA CROIX and A. GOSSERIES, *Population Policy through Tradable Procreation Entitlements*, *International Economic Review*, 50, 507-542, **2009**.
- ▶ A. GOSSERIES, *Three models of intergenerational reciprocity*, in Axel Gosseries & Lukas Meyer (eds.), *Intergenerational Justice*, Oxford: Oxford University Press, **2009**.

Funding

ARC "Sustainability"

KEY WORDS

Criteria, growth
Population policy
Intergenerational justice
Short-termism
Sustainable technology
Childlessness
Environmental constraint
Optimality
Fairness

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Conceptual and Ethical Aspects of Sustainable Development

SENIOR SCIENTIST:

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Research Field and Subjects

The research focuses on sustainable development concepts; this includes epistemological aspect of this concept, including the role of scientific experts in elaboration of ecological policy. Ethical aspects are also explored. These have to do with “respect for nature”, which requires specific elucidation and the analysis of specific scientific practices. Such analyses are more relevant in relation with specific questions and if conducted jointly with specialists in radiological protection, preservation and management of equatorial forests...

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Funding

- ▶ Prix Tractebel
- ▶ FNRS, Belgium
- ▶ FSR, UCL

Partnership

- ▶ UCL, ENGE
- ▶ UGent
- ▶ FANC, Bruxelles
- ▶ UCC, Kinshasa

KEY WORDS

Ethics
Ecology
Sustainable Development
Expertise
Science
Precautionary Principle
Responsibility Principle
Nature
Modernity
Democracy

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Epistemology of Sustainable Development

SENIOR SCIENTIST:

▶ Stéphane LEYENS

Research Field and Subjects

Since its coining in the eighties, “sustainable development” has become such a popular concept - a *buzz word* used by anybody anytime - that it is hardly clear what the concept really means. Is it mainly expressing concerns of ecology, of development and/or of social justice? The idea of this research on the epistemology of sustainable development is to make explicit the different meanings theoreticians and actors alike put under this concept, and to clarify the issues that lie behind.

KEY WORDS

Epistemology
Concept
Sustainable Development, theories

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Representative References

- ▶ S. LEYENS, *Développement durable ou décroissance conviviale ? Quelques figures politiques*. Libre Cours, n°61, **2007**.
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- ▶ S. LEYENS, *Du développement durable à la décroissance, aller et retour*. Carnets du Développement Durable, n°1, **2010**.

Products and Services

- ▶ Seminar on « Epistemology of Sustainable Development », Department of Sciences, Philosophies and Societies, University of Namur.
- ▶ Publication of the proceedings of the seminar.

Environmental History

SENIOR SCIENTIST:

- ▶ Isabelle PARMENTIER

Research Field and Subjects

The research focuses on the history of environment in Belgium (especially in towns) from the 16th to the 21st century. The main topics studied are air pollution, water pollution, soil contamination, noise pollution, visual pollution. Special attention is given to the study of mentalities, rules, and infrastructures.

Representative References

- ▶ I. PARMENTIER. *L'or et l'ordure. La gestion des déchets urbains au XVIII^e siècle en Belgique* in *Histoire urbaine*, n° 18, p. 61-76, **2007**.
- ▶ I. PARMENTIER. *Histoire de l'environnement en Pays de Charleroi, 1730-1830. Pollution et nuisances dans un paysage en voie d'industrialisation*, Bruxelles (Académie royale de Belgique. Mémoire de la Classe des Lettres, coll. in-8°, 3^e sér., XLVII, n° 2055), 410 p., ill., **2008**.

Awards

- ▶ Prix de l'Académie royale des Sciences, des Lettres et des Beaux-Arts de Belgique (2005)
- ▶ Prix Edgard Spaelant de la Province de Brabant (1993)

Funding

- ▶ FRS-FNRS

Partnership

- ▶ Environmental History FNRS Network
- ▶ ESEH European Society for Environmental History

Main Equipment

- ▶ Departmental pool of documentation

Products and Services

- ▶ Identification of ancient pollution (soils pollution, etc.) registered in different publications

KEY WORDS

History
Pollution
Factories
Water courses
Towns
Soil
Air
Noise
Forest
Risk

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Organic Agriculture

SENIOR SCIENTIST:

► Denise VAN DAM

Research Field and Subjects

Searches are conducted by an interdisciplinary team on organic farming in various regions in France and Belgium. They consist of an in-depth analysis of various dimensions such as the conversion process, links to institutions, learning processes, communication, the role of women, the role of emotions and collective action.

KEY WORDS

Collective action
Organic agriculture
Conversion process
Emotions
Knowledge
Life history
Projets collectifs

Representative References

- D. VAN DAM. *Les agriculteurs bio : vocation ou intérêt ?*, PUN, Namur, **2005**.
- D. VAN DAM. *L'agriculture biologique : un autre modèle agricole ou une opportunité économique* in Y. LE CARO, PH. MADELINE, G. PIERRE, *Agriculteurs et territoires*, PUR, pp. 81-103, **2007**.
- D. VAN DAM. *Les agriculteurs en quête de sens* in La Revue Nouvelle, volume 2007/° 9, pp. 53-61, **2007**.
- J. NIZET, D. VAN DAM, M. DEJARDIN. *La cohérence des comportements professionnels et privés chez les viticulteurs biologiques* in Recherches sociologiques et anthropologiques, volume 2008/2, **2008**.
- D. VAN DAM. *Une exploration des liens entre dynamiques identitaires et développement territorial : le cas des agriculteurs biologiques* in Ruralia, volume 2009/°18-19, pp. 291-302, **2009**.
- D. VAN DAM, J. NIZET, M. DEJARDIN. *Les limites de la transmission familiale chez les viticulteurs bio alsacien*, in N. BURNAY, A. KLEIN (ed.). *Figures contemporaines de la transmission*, Namur, Pun, p. 347-358, **2009**.
- D. VAN DAM, J. NIZET, M. DEJARDIN, M. STREITH. *Les agriculteurs biologiques : ruptures et innovations*. Educagri, Dijon, **2009**.

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Partnership

Informal network Grabi (group of research about organic agriculture) that includes colleagues of the universities Paris-Nanterre, Besançon, FUNDP, UCL and ILVO

Conservation genetics and biodiversity

SENIOR SCIENTISTS:

- ▶ Philippe BARET
- ▶ Anne-Laure JACQUEMART

Research Field and Subjects

Conservation genetics is a key component of our understanding of the maintenance of biodiversity. Based on new tools such as molecular markers and computationally intensive methodologies, the conservation genetics approaches are used to describe the dynamics of populations, compare different biological systems and assess the impact of anthropogenic actions such as habitat fragmentation and spread of invasive species. Our expertise covers both animal and plant species i.e. diversity of fishes, sheep and cattle, invasive plants, and relations between pollinator decrease and entomophilous plant survival.

A specific attention is paid to interaction between human activities and diversity, on socio-economical aspects and ecological habitat restoration and policy.

Representative References

- ▶ A. FADLAOUI, J. ROOSEN, P.V BARET. *Setting priorities in farm animal conservation choices - expert opinion and revealed policy preferences*. European Review of Agricultural Economics 33(2): 173-192, **2006**.
- ▶ M. PAIRON, O. CHABRERIE, C. MAINER CASADO, A.L JACQUEMART. *Sexual regeneration traits linked to black cherry (Prunus serotina Ehrh.) invasiveness*. Acta Oecologica, 30 238-247, **2006**.
- ▶ A.L JACQUEMART, C. GILLET, V. CAWOY. *Floral visitors and honeybee importance on buckwheat (Fagopyrum esculentum Moench.) in central Belgium*. J.Hort. Sci. & Biotech., 82, 104-108, **2007**.
- ▶ M. PAIRON, D. POTTER, A.L JACQUEMART. *Detection and characterization of genome-specific microsatellite markers in the allotetraploid Prunus serotina*. J.Amer. Soc. Hort. Sci., 133, 390-395. **2008**.
- ▶ V. VANPARYS, P. MEERTS, A.L JACQUEMART. *Plant-pollinator interactions: comparison between an invasive and a native congeneric species*. Acta Oecologica, 34,361-369. **2008**.
- ▶ X. JANSSENS, J. MICHAUX, M.C FONTAINE, R. LIBOIS, J. DE KERMABON, P. DEFOURNY, P.V BARET. *Genetic pattern of the recent recovery of European otters in southern France*. Ecography 31(2) 176-186, **2008**.

- ▶ G. VANLOQUEREN, P.V BARET. *Why are ecological, low-input, multi-resistant wheat cultivars slow to develop commercially? A Belgian agricultural 'lock-in' case study*. Ecological Economics 66:436-446, **2008**.

Awards

- ▶ Prix Jean Lebrun, Académie royale des Sciences de Belgique, 2000, to A.-L. Jacquemart

Funding

- ▶ FNRS
- ▶ Direction générale de l'Agriculture (Ministère de la Région wallonne)
- ▶ Direction générale de l'environnement et des ressources naturelles (Ministère de la Région wallonne)

Partnership

- ▶ GLOBALDIV network
- ▶ ULg, ULB, VUB, UMH, Ghent University, UIA
- ▶ Jardin botanique National Belgique Museum histoire naturelle, Paris, et Luxembourg
- ▶ Université Lille-1, Université Montpellier-1, CEFE Montpellier, Université Jules Verne Picardie
- ▶ College of Charleston, University of Leiden, Université de Lausanne

Main Equipment

- ▶ Lab of genetics, genetic and statistical softwares
- ▶ Pollinator monitoring
- ▶ Plant reproductive system monitoring
- ▶ Growth chambers

Products and Services

- ▶ Genetic and statistical analyses
- ▶ Molecular markers (microsatellites)
- ▶ Seed germination
- ▶ Insect and plant determination
- ▶ Plant mating system
- ▶ Guidelines for restoration and management (open ecosystems and forests).

KEY WORDS

Conservation biology
Invasion biology
Population genetics
Endangered species
Biodiversity conservation
Habitat management

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Environmental Economics and Management

SENIOR SCIENTISTS:

- ▶ Thierry BRECHET
- ▶ Henry TULKENS
- ▶ Raouf BOUCEKKINE
- ▶ Stéphane ZUBER
- ▶ Thomas BAUDIN

Research Field and Subjects

The research field of this group is environmental economics and management, with a focus on the use and development of mathematical and modelling tools, be it theoretical or applied.

The main research topics are as follows:

- (i) Design and properties of policy instruments for environmental regulation. This item covers a wide range of issues including fiscal policies and tradable emission permits, market structures.
- (ii) Inter-generational dimensions of environmental issues with overlapping generation models, population dynamics and natural resources (forests).
- (iii) Climate economics and climate negotiation analysis with game theory and applied integrated assessment models. Optimal policy mix between growth, abatement and adaptation.
- (iv) Definition and measure of firm's environmental performance, and the effect of environmental innovation on firm's performance. Methodology for selecting the best available techniques.

Representative References

- ▶ T. BRÉCHET, P. MICHEL. *Environmental performance and equilibrium*. Canadian Journal of Economics 40(4), 1078-1099, **2007**.
- ▶ T. BRÉCHET, P. VAN BRUSSELEN. *Le pic pétrolier: un regard d'économiste*. Reflets & Perspectives de la Vie Économique XLVI (4), 63-81, **2007**.
- ▶ T. BRÉCHET, P.A. JOUVET. *Environmental innovation and the cost of pollution abatement revisited*. Ecological Economics 65(2), 262-265, **2008**.
- ▶ T. BRÉCHET, A. GÉRARD AND G. MION. *Une évaluation quantitative des nuisances subjectives de l'aéroport de Bruxelles-National*. Regards Économiques 66, **2009**.
- ▶ T. BRÉCHET, H. TULKENS. *Beyond BAT: selecting optimal combinations of available techniques*. Journal of Environmental Management 90, 1790-1801, **2009**.
- ▶ T. BRÉCHET AND P-A. JOUVET. *Why environmental management may yield no-regret pollution abatement options'*. Ecological Economics 68(6), 1770-1777, **2009**.

▶ T. BRÉCHET, S. LAMBRECHT. *Family altruism with a renewable natural resource and population growth*. Mathematical Population Studies 16(1), 60-78, **2009**.

▶ T. BRÉCHET, S. LAMBRECHT AND F. PRIEUR. *Intertemporal transfers of emission quotas in climate policies*. Economic Modelling 26(1), 126-143, **2009**.

Funding

Chair Lhoist Berghmans

Partnership

- ▶ University Paris I
- ▶ MIT Global Change Forum
- ▶ EHSAL
- ▶ ASTR-UCL

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Towards a sustainable management of pond biodiversity at the landscape level

SENIOR SCIENTISTS:

- ▶ Annick CASTIAUX
- ▶ Patrick KESTEMONT

Research Field and Subjects

Ponds are very interesting environments. They were artificially built but they contribute to biodiversity. In the past, they were considered as an important resource, essentially because they provided water to cattle. Then they became suspicious because of parasitic infections. However, they should be maintained and protected since they are now part of the agricultural biodiversity. On one part the research looks at objective analyses of ponds ecological quality. On the other part, it looks at the behaviours and opinions of all involved stakeholders (owners, NGOs, local authorities, etc.) and try to infer advices for better public management of those biodiversity resources. FUNDP team is in charge of this second part of the project.

Funding

Belgian Science Policy

Partnership

- ▶ Natural Sciences Institute, Brussels
- ▶ KULeuven
- ▶ Universiteit Gent
- ▶ Centre de Recherche Publique Gabriel Lippman, Luxembourg

Representative References

- ▶ E. GRAITSON, K. MORELLE, N. FEREMANS, A. CASTIAUX. *La vie des mares de nos campagnes*. Claude Delbeuck, Namur, 169p, **2009**.
- ▶ K. MORELLE, A. CASTIAUX. *L'évolution des mares en Belgique : entre Histoire humaine et Histoire de l'Environnement, Actes des Première Rencontres d'Histoire de l'environnement, de FUNDP*, Namur, Décembre 2008, **2009**.
- ▶ K. MORELLE, A. CASTIAUX. *Farmers' perception on rural ponds: A sustainable management?* Proceedings of the NJF conference, Tartu, Estonia, **September 2009**.
- ▶ K. MORELLE, A. CASTIAUX. *Les mares, objets méconnus de nos paysages : Etude des perceptions et mise en perspective historique*. Actes du colloque « Au fil de l'eau, MSH Clermont-Ferrand, France, **Mars 2009**.
- ▶ K. MORELLE, A. CASTIAUX. *Socio-historical relevance of ponds to stakeholders*. ABER-BVLE Symposium, Bruxelles, **Avril 2009**.

KEY WORDS

Pond management
Agriculture
Biodiversity
Stakeholders
Perception

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**[www.fundp.ac.be/facultes/eco/departements/
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Biodiversity: Laws and Policies

SENIOR SCIENTISTS:

- ▶ CEDRE-SERES

Research Field and Subjects

Biodiversity conservation and sustainable use impose a good command of legal issues and a capacity of developing adequate and innovative tools with full knowledge of their juridical and ecological ins and outs. The research focuses on the implications and relevance of the current legal protection frameworks dealing with nature protection (habitats, species) and biodiversity preservation at all scales (genes, species, ecosystems), at international, European and local levels. It deals with the integration of biodiversity protection requirements into sectoral policies (land use planning, agriculture, fisheries, etc.). It also explores adequate solutions to improve the current frameworks, within or outside the classical assortment of legal instruments.

Representative References

- ▶ CEDRE, *Le zonage écologique*, Bruxelles, Bruylant, **2002**.
- ▶ N. de SADELEER et C.-H. BORN, *Le droit international et communautaire de la biodiversité*, Paris, Dalloz, 780 pp. **2004**.
- ▶ COLL., *Natura 2000 et le droit*, Bruxelles, Bruylant, 340 pp. **2004**.
- ▶ C.-H. BORN, *Guide juridique des zones protégées en Wallonie*, Jambes, Ministère de la Région wallonne, Division de la Nature et des Forêts, 380 pp. **2005**.
- ▶ D. MISONNE, *Espèces envahissantes, analyse du cadre juridique*, rapport réalisé pour le SPF Santé publique, Sécurité de la chaîne alimentaire et Environnement, 42 p. juin **2006**.
- ▶ C.-H. BORN, « Les mesures agro-environnementales », in C.-H. BORN et F. HAUMONT (dir.), *Actualités du droit rural, vers une gestion plus durable des espaces ruraux ?*, Bruxelles, Bruylant, à paraître en **2010**.

Funding

Regional and federal public authorities
CUD

Partnership

- ▶ IUCN (CEL)
- ▶ ELNI
- ▶ Abefdatu
- ▶ Observatoire juridique européen Natura 2000
- ▶ Ecosphere

Products and Services

- ▶ Legal advice
- ▶ Drawing up legislation
- ▶ Seminars and conferences
- ▶ Publications
- ▶ Master's degree on Environmental Law and Country Planning Law

KEY WORDS

Biodiversity conservation and sustainable use
Nature conservation
Flora and fauna
Habitats
Species
Invasive species
Genetic resources
Ecosystem
Compensation
Restoration
Law
Policy

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In vivo and in vitro ecotoxicology

SENIOR SCIENTISTS:

- ▶ Cathy DEBIER
- ▶ Yvan LARONDELLE
- ▶ Jean-François REES

Research Field and Subjects

The research focuses on the development *in vivo* and *in vitro* of models for the study of xenobiotics' impacts on fish, and on marine and terrestrial mammals. These cellular models include lymphocytes, erythrocytes, adipocytes and Precision-Cut Liver Slices (PCLS). Effects on gene expression (q-RT-PCR), oxidative processes (redox status, DNA damage, antioxidant resistance), vitamins and fat metabolism as well as cell metabolic processes (CYP450 activity, ATP content) are measured.

Representative References

- ▶ C. DEBIER, P.P POMEROY, J.P THOME, E. MIGNOLET, T. DE TILLESSE, Y. LARONDELLE. *An unexpected parallelism between PCBs and vitamin A in seal milk*. Aquatic Toxicology, 68, 179-183, **2004**.
- ▶ C. DEBIER, G.M. YLITALO, M. WEISE, F. GULLAND, D.P COSTA, B.J LE BOEUF, T. DE TILLESSE, Y. LARONDELLE. *PCBs and DDT in the serum of juvenile California sea lions: Associations with vitamins A and E and thyroid hormones*. Environ Pollut. 134: 323-332, **2005**.
- ▶ R. LE GALL, C. MARCHAND, J.F REES. *Impacts of antibiotics on in vitro UVA-susceptibility of human skin fibroblasts*. European Journal of Dermatology 15, 146-151, **2005**.
- ▶ C. DEBIER, C. CHALON, B.J LE BOEUF, T. DE TILLESSE, Y. LARONDELLE, J.P THOME. *Mobilization of PCBs from blubber to blood in Northern elephant seals (Mirounga angustirostris) during the post-weaning fast*, Aquatic Toxicology, 80, 149-157, **2006**.
- ▶ S. BOUREZ, C. REMACLE, Y. SCHNEIDER, Y. LARONDELLE, C. DEBIER. *Development and utilization of an in vitro model of primary cultures of rat adipocytes: Physiological and toxicological approach*. Annals of nutrition and metabolism, 51 : 396, **2007**.
- ▶ B. LEMAIRE, I.G. PRIEDE, M.A. COLLINS, D.M. BAILEY, N. SHTICKZELLE, J.P. THOMÉ, J.F. REES. *Effects of organochlorines on cytochrome P450 activity and antioxidant enzymes in liver of roundnose grenadier Coryphaenoides rupestris*. Aquatic Biology, 8: 161-168, **2010**.

Funding

- ▶ FRFC
- ▶ FNRS
- ▶ ARC
- ▶ FSR

Partnership

- ▶ Station Biologique de Roscoff
- ▶ University of Liège
- ▶ Crocker, Sonoma State University, USA
- ▶ INRS, Québec

Specific Tools & Main Equipment

- ▶ Cell culture facilities
- ▶ Aquaculture facilities,
- ▶ Luminometers,
- ▶ Lyophilisator
- ▶ HPLC-DAD
- ▶ GC-FID
- ▶ GC-MS

Products and Services

- ▶ Oxidative damage (TBARS, DNA)
- ▶ Antioxidant activity (CAT, SOD, GPX, GSH)
- ▶ Fatty acid profile
- ▶ Vitamin A and E contents

KEY WORDS

Oxidative stress
DNA damage
PCB
Antioxidant
Persistent organic pollutant
Marine mammal
Biomarkers
Vitamins
Aquaculture

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Fungal Bioremediation and Biosynthesis

SENIOR SCIENTISTS:

- ▶ Stephan DECLERCK
- ▶ Estelle ENAUD

Research Field and Subjects

The research is aimed at solving industrial and environmental issues using the potentialities of fungi, and particularly white rot fungi. The following four major topics are developed:

Fermentation processes. Studies of natural molecules involved in fungal cell communications in order to improve productivity at macro industrial-scale of the commercially important bio-products. Screening and study of fungal strains for the production of oxidative enzymes useful in bioremediation, biorefinery and biosynthesis.

Bioprocess expertise. Production and Implementation of new enzymatic biocatalysts. Design of a Granular bio-catalytic material for bioremediation and or biosynthesis of valuable products.

Bioremediation. Screening of fungal strains and enzymes and design of bioprocesses for the safe removal of xenobiotics from contaminated industrial effluents.

Biosynthesis. Development of bioprocesses for the transformation of industrial and agricultural byproducts, into valuable compounds (such as bio-dyes and aroma) or renewable energy sources.

Products and Services

- ▶ Targeted screenings of fungal strains for bioremediation and biosyntheses.
- ▶ Immobilization of enzymes on solid carriers.
- ▶ Design, start-up and application of bioremediation and biosynthesis bioprocesses.

Main Equipment

- ▶ Bioreactor (10 liters).
- ▶ High Performance Liquid chromatography coupled with mass spectrometry (HPLC/MS)
- ▶ Capillary electrophoresis (CE)
- ▶ Gel electrophoresis (PAGE and SDS-PAGE)
- ▶ Spectrophotometer
- ▶ Integrated bioprocess systems
- ▶ Clark electrodes

Representative References

- ▶ TROVASLET M., ENAUD E., GUIAVARC'H Y., CORBISIER A.-M., VANHULLE S., *Kinetic characterisation of a Pycnoporus sanguineus laccase (LAC-1) in relation to the textile industry wastewater treatment.* Enzyme and Microbial Technology V41 (3) p 368-376, **2007**.
- ▶ VANHULLE S., ENAUD E., TROVASLET M., BILLOTTET L., KNEIPE L., HABIB JIWAN J.-L., MARCHAND-BRYNAERT J., CORBISIER A.-M., *Coupling occurs before breakdown during biotransformation of Acid Blue 62 by white rot fungi.* Chemosphere V70 (6) p 1097-1107, **2008**.
- ▶ VANHULLE S., TROVASLET M., ENAUD E., LUCAS M., TAGHAVI S., VAN DER LELIE D., VAN AKEN B., FORET M., ONDERWATER R., WESENBERG D., AGATHOS S., SCHNEIDER Y.-J., CORBISIER A.-M., *Decolourisation, cytotoxicity and genotoxicity reduction during a combined ozonation/fungal treatment of dye contaminated wastewater.* Environmental Science & Technology V42 (2), p 584-589, **2008**.
- ▶ BRUYNEEL F., ENAUD E., BILLOTTET L., VANHULLE S., MARCHAND-BRYNAERT J., *Regioselective synthesis of 3-hydroxyorthanilic acid and its biotransformation with laccase into a novel phenoxazinone dye.* European Journal of Organic Chemistry n°2, p 72-79, **2008**.
- ▶ ENAUD E., TROVASLET M., BRUYNEEL F., BILLOTTET L., KARAAASLAN R., COPPENS P., CASAS A., JAEGER J., HAFNER C., ONDERWATER R., CORBISIER A.-M., MARCHAND-BRYNAERT J., VANHULLE S. (2010). *A Novel Azoanthraquinone Dye Made Through Innovative Enzymatic Process.* Dyes and Pigments V85 (3), p99-108, **2010**.

Patents

- ▶ VANHULLE S., LUCAS M., MERTENS V., GOBEAUX B., BOLS C-M., BUCHON F., WESENBERG D., AGATHOS S., CORBISIER A-M. (2002) Sustainable process for the treatment and detoxification of liquid waste. World patent WO03/035561.
- ▶ BRUYNEEL F, JAROSZ-WILKOLAZKA A, POLAK J, BOLS CM, VANHULLE S, ENAUD E, BASOSI R, POGNI R, JAGER JI, HERCHER C, MARCHAND-BRYNAERT J (2008). Phenoxazines dyes. US61/078,670)
- ▶ ENAUD E, MARCHAND-BRYNAERT J, BOLS CM, GROSLAMBERT S, TRON T, IACAZIO G, SENER M, KARAASLAN R, JAGER JI, HERCHER C, VANHULLE S (2008). New azo dyes. US 61/078,675.

Partnership

Academic collaborations:

- ▶ Université de Liège (Centre d'Ingénierie des Protéines)
- ▶ University of Naples (Italy)
- ▶ University of Westminster (UK)
- ▶ University of Marseille (France)
- ▶ Instituto de Biologica Experimental e Biotecnologica (Portugal)
- ▶ Maria Curie Sklodowska University (Poland)
- ▶ University of Siena (Italy)
- ▶ Istanbul Technical University (Turkey)
- ▶ UFZ-Centre of environmental research Leipzig-Hall (Germany)
- ▶ The questor center (UK)
- ▶ Institute of chemical technology, Prague
- ▶ University of Pécs
- ▶ University of Turku
- ▶ FUSAGx (Belgium)

Industrial collaborations:

- ▶ Wetlands Engineering (Belgium)
- ▶ Realco (Belgium)
- ▶ Hydrotox GmbH (Germany)
- ▶ Setas Kimya San AS (Turkey)
- ▶ Celabor (Belgium)
- ▶ BLC Leather Technology Center (UK)
- ▶ Ovelacq (Belgium)
- ▶ Conceria Antiba (Italy)
- ▶ Tintoria gori manifattura lucchese lane e fibre (Italy)

KEY WORDS

White rot fungi
Oxidative enzymes
Bioconversion
Bioremediation
Enzyme immobilization
Granular biocatalytic material

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Institutional analysis of collective action arrangements and regulation for biodiversity conservation and sustainable use

SENIOR SCIENTIST:

▶ Tom DEDEURWAERDERE

Research Field and Subjects

Biodiversity governance: organic agriculture, sustainable forestry, genetic resources, biodiversity information infrastructure.

The research unit on Biodiversity and Reflexive governance (BIOGOV) is a research unit of the Centre for the Philosophy of Law (CPDR) at the Université catholique de Louvain (UCL). Its focus is on collective learning in the field of sustainable development. This research is developed inside an international and national network (REFGOV and IUAP VI/06 respectively).

The BIOGOV unit has developed a set of comparative case studies into the institutional design for the provision of global and local environmental services. Two recent case studies (Dedeurwaerdere, Iglesias, Weiland and Halewood, 2009; Dedeurwaerdere 2009) illustrate the work of the research unit. The first case study is at the local level and analyses the governance characteristics of an innovative instrument for sustainable forest management in Europe, the so-called "*bosgroepen*". This case study illustrates the change in the decision-making procedures in the public sector, including in forestry, with a change from government top-down regulations to decentralized interactions between state and non-state actors in a contractual framework for public service provision. The second case study analyses social learning in natural resource management at the global level. Its focus is in particular on the role of the international centres of the Collaborative Group of International Agriculture Research (CGIAR-centers) in carving out and maintaining a global commons in genetic resources, which has led to the International Treaty on Plant Genetic Resources in Food and Agriculture (ITPGRFA) ratified in 2004. This second case is a clear one where social learning in cooperative networks has played a part in creating a *de facto* open-access regime in genetic resources.

Representative References

- ▶ DEDEURWAERDERE T., IGLESIAS M., WEILAND S., HALEWOOD M., *The use and exchange of microbial genetic resources for food and agriculture*. Background Study Paper of the Commission on Genetic Resources for Food and Agriculture n°46, 67pp, **2009**.
- ▶ DEDEURWAERDERE T., *Social Learning as a Basis for Cooperative Small-Scale Forest Management*. *Small-scale Forestry* 8:193-209, **2009**.
- ▶ DEDEURWAERDERE T., KRISHNA V., PASCUAL U., "An evolutionary institutional approach to the economics of bioprospecting", in KONTOLEON A. and PASCUAL U. (eds), *A Handbook of Biodiversity Economics*, Cambridge University Press, Cambridge, pp. 417-445, **2007**.
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Funding

- ▶ Belspo
- ▶ Subnetwork on Global Public Goods of Refgov integrated project (RTD FP6 CIT3-513420 REFGOV), coordinated by the CPDR.

KEY WORDS

Biodiversity
Environmental governance
International regime theory
Sustainable Development
Institutional analysis
Governance theory

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Climate change and carbon management: tropical forests monitoring

SENIOR SCIENTISTS:

- ▶ Pierre DEFOURNY
- ▶ Emmanuel HANERT
- ▶ Patrick BOGAERT

Research Field and Subjects

- ▶ Characterisation and spatio-temporal modelling of forest ecosystems.
- ▶ Development of automatic methods for forest change detection.
- ▶ Modelling of tropical forest ecosystems for the monitoring and prediction of carbon cycle at short and long term.
- ▶ Deforestation rate estimates at local, regional and national scale.
- ▶ Technological transfer and information processing tools development for monitoring through remote sensing.
- ▶ Methodological concepts and development of computing methods for automatic detection of deforestation and forest exploitation for operational processing of large datasets.
- ▶ Spatial modelling of deforestation dynamics based on geographical information systems and spatial models.
- ▶ Multi-agent and cell automate modelling systems
- ▶ Spatial remote sensing, land use and time series processing for monitoring at local, regional and global scale.

Representative References

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Funding

- ▶ European Union FP7 program
- ▶ Belgian Sciences Policy Office (Belspo)
- ▶ Region Wallonne (RW)
- ▶ European Spatial Agency (ESA)
- ▶ Food and Agriculture Organisation (FAO)

Partnership

- ▶ UNESCO
- ▶ Joint Research Centre (JRC)
- ▶ COMIFAC

Main Equipment

- ▶ Professional softwares for GIS and remote sensing : ArcGIS, StarCarto, Mapinfo, Idrisi, Imagine, ENVI, e-Cognition Definiens as well as A0 Digitising table and A0 plotter.
- ▶ Large range of Global Positioning Systems (GPS) receivers including Leica and TRIMBLE systems.
- ▶ Multiprocessor high speed computing servers offering large storage capacity and data processing
- ▶ Fully equipped training classroom facilities

Products and Services

- ▶ Integration of 10-years time series SPOT-VEGETATION in a land surface model for prediction of terrestrial carbon dynamics in climate change context (SP PPS).
- ▶ Set up of the "Observatoire des Forêts d'Afrique centrale" and estimation of deforestation rate, degradation, regeneration and reforestation for 6 countries (UE Project FORAF)
- ▶ Identification and quantification of the causes of deforestation and evolution of forest cover at country scale for RDCongo (FAO Coordination REDD)
- ▶ Development of an operational method for global change detection of forest cover. (FP7 -GEOLAND-2, FAO Forest Ressources Assessment 2010 and JRC TREES)
- ▶ First global land cover map at 300m resolution for the world (Project GLOBCOVER - ESA)

KEY WORDS

Forest mapping
Forest exploitation monitoring
Geomatics
Land use
Deforestation modelling
Data assimilation in carbon cycle models
Geographical Information Systems
Remote sensing

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Ecological studies in Lake Kivu

SENIOR SCIENTISTS:

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- ▶ François DARCHAMBEAU

Research Field and Subjects

Lake Kivu, which is located in the western Rift Valley between Rwanda and the Democratic Republic of Congo, has unique limnological characteristics in that its temperature and salinity increase in the deep water layers because of the presence of geothermal sources at different depths. The deep monimolimnion is rich in dissolved gases, such as, in particular, carbon dioxide (CO₂) and methane (CH₄), which are produced by bacteria decomposing sediments. The release of a fraction of these gases, which could be triggered by a magma eruption within the lake, would have catastrophic consequences for the two million people living on the shore. A significant change in zooplankton community occurred further to the introduction in the 1950's of the Tanganyika sardine *Limnothrissa miodon*. The most visible consequence was the disappearance of the large grazer, *Daphnia curvirostris*, and a total decrease of the zooplankton biomass. Nevertheless, the introduction of the Tanganyika sardine has enabled the development of a relatively productive fishery which will provide the local populations with an invaluable protein resource for several decades. The fishery and the lake ecosystem are nowadays threatened by two new types of disturbance: the introduction of another fish species from Lake Tanganyika, likely to compete with the sardine, and by energy production projects consisting of methane exploitation. The research team explores the ecological functioning of the biozone, with a view to assess past, present and future impacts on this unique lake ecosystem.

Research in particular focuses on limnology, nutrients, plankton, and on production of bacteria, phytoplankton and metazooplankton.

Representative References

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Funding

FNRS

Partnership

ULg, Chemical Oceanography Unit (Dr. A. Borges)
ULB, Study of Aquatic Systems (ESA, Dr. P. Servais)

International collaborations:

- Eawag, Kastanienbaum, Switzerland
- Institut Supérieur Pédagogique, Bukavu, RD Congo
- ICM (Institut de Ciències del Mar), Departament de Biologia Marina i Oceanografia, Barcelona, Spain (Dr. J. Gasol)
- Environmental Microbiology, University of Girona, Spain

Specific Tools & Main Equipment

► Sampling devices, microscopes,
HPLC, equipment for molecular ecology, flow cytometry, field sensors...

Products and Services

► Limnology, taxonomy of phytoplankton and zooplankton, measurement of ecological processes, molecular analyses (DGGE, sequencing), HPLC analysis of marker pigments, GC analysis of marker fatty acids, flow cytometry, modelling.

KEY WORDS

Lakes
Ecosystem function
Sustainable development
Carbon
Nutrients
Food web
Fishery
Picoplankton
Small eukaryotes

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Cyanobacterial blooms: monitoring, toxicity, diversity, modelling and management

SENIOR SCIENTISTS:

- ▶ Jean-Pierre DESCY
- ▶ Samuel PIRLOT
- ▶ Gisèle VERNIERS
- ▶ Bruno LEPORCQ

Research Field and Subjects

Cyanobacteria blooms are an emerging problem, which threatens several uses of surface waters (drinking water supply, recreation) and might seriously and negatively impact on wildlife and human health. Assessing the bloom-related risks involves monitoring water bodies at risk, identifying the strains using morphological and molecular methods, detecting the genes involved in toxin synthesis, measuring the toxins in the environment, and setting up measures to avoid public exposure and favour protection of the environment.

Two successive B-BLOOMS projects have been launched so far, consisted of a study of the cyanobacteria blooms and cyanotoxins in Belgium, and has involved intensive sampling of eutrophic water bodies. The first phase of the program was run in 2007-2008: it covered the study of five reference lakes located in Flanders, Brussels and Wallonia. The second phase is aimed at collecting additional data through contacts with the water authorities. A significant activity has consisted in interacting with, and transferring knowledge to, the water managers such as ISSeP in Wallonia.

B-BLOOMS projects have resulted in the production of a database on bloom developments in a series of Belgian water bodies, with the associated environmental factors, the toxin concentration and the presence/absence of *mcy* genes. These data will be useful for developing prediction models and assessing water bodies compliance with two European directives: the Water Framework Directive and the directive on bathing areas (2006/7/CE). The products may be used for identifying the measures to be taken for a sustainable development of bathing areas and for testing management measures with simulation models.

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Funding

- ▶ BELSPO, Science for a sustainable development
- ▶ Protectis SA

Partnership

UGent (University of Gent)
Prostistology and Aquatic Ecology

VUB (Vrije Universiteit Brussel)
Plant Science and Nature Management)

ULg University of Liège
CIP (Center for Protein Engineering)
AQUAPÔLE, modelling unit
University of Dundee, Scotland University of Liège

Specific Tools & Main Equipment

- ▶ Sampling devices, microscopes, HPLC, equipment for molecular ecology

Products and Services

- ▶ Identification of cyanobacteria, measurement of cyanotoxins in bloom material, molecular analyses (DGGE, sequencing)

KEY WORDS

Lakes
Eutrophication
Cyanobacteria
Cyanotoxins

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Environmental Process Modelling, Monitoring, Control and Real-Time Optimisation

SENIOR SCIENTIST:

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Research Field and Subjects

The main area of expertise covers the mathematical modelling of the dynamics of biological systems, the analysis of the model properties, and the design and application of model-based monitoring, control algorithms and real-time optimisation tools, with an application to ecological and environmental systems and processes.

Optimization of the on-line operation of environmental and ecological systems requires the development of appropriate monitoring and control tools. Typically, two key issues should be tackled : first one is related to the difficulty to model the complex dynamics including those of the biological/microbial systems in reliable way. The second is about the difficulty that lies in the absence of cheap and/or reliable on-line sensors for the key system variables. These issues are in the core of the expertise developed over the last 25 years.

Well-accepted trends in the industry require plants that meet safety and environmental requirements in a sustainable way. Besides, issues like protection against contamination and coexistence of different micro-organisms are important ones in the biotechnology industry today. This implies on the one hand the integrated use of environmental processes within the industrial plant, and on the other hand the development of appropriate techniques to handle coexistence or prevent contamination.

The developed approaches are largely based on mass (and energy) balance models. One of the underlying ideas is to incorporate the knowledge about the process dynamics (e.g. basically, the reaction network and the material balances) and (microbial) ecology concepts in monitoring and control algorithms; moreover the latter are able to deal with process uncertainties (in particular on the reaction kinetics) by introducing an adaptation scheme.

The complexity of the biological system dynamics is also handled by considering potentially complex metabolic networks and microbial ecology to emphasize the interactions between the different, maybe competing, species. Monitoring is related in particular to the design of software sensors that are based

on the available knowledge of the process dynamics and the limited number of process variables measured on-line in order to reconstruct on-line the values of the unmeasured key process variables. Particular attention is also paid to the design and implementation of real-time optimisation methods via adaptive extremum seeking control techniques that allow the process to reach *a priori* unknown optimal operating points, trajectories or profiles.

Several research projects, including the following EC projects, have been conducted in cooperation with industrial partners:

- EOLI («Efficient Operation of Urban Wastewater Treatment Plants»),
- TELEMACH («TELE-Monitoring and Advanced teleControl of high yield wastewater treatment plants»), and
- AMOCO («Advanced Monitoring and Control for Improved Stable Operation of Wood Processing Waste Water Treatment Plants»).

Representative References

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- D. DOCHAIN. *Bioprocess Control*. ISTE, London, **2008**.
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Funding

- ▶ European Commission
- ▶ Private companies

Partnership

- ▶ INRA
- ▶ Laboratoire d'Analyse des Systèmes et de Biométrie, Montpellier (DR A. RAPAPORT)
- ▶ Laboratoire de Biotechnologie de l'Environnement, Narbonne (DR J. HARMAND & J.P STEYER)
- ▶ Université de Technologie de Compiègne, Département de Génie Chimique (PROF. A. PAUSS, DR. O. SCHOEFS)
- ▶ Ecole Polytechnique de Montréal, Département de Génie Chimique (PROF. M. PERRIER)
- ▶ Queen's University, Chemical Engineering Department (PROF. M. GUAY & J. RAMSAY)

Main Equipment

Computers

Products and Services

Dynamical models
Software sensors
Control algorithms
Real-Time Optimisation tools

KEY WORDS

Modelling
Monitoring
Estimation
Software sensor
Control
Real-time optimisation
Population balance
Metabolic network
Microbial ecology

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Forest planning

SENIOR SCIENTISTS:

- ▶ Christine FARCY
- ▶ Tom DEDEURWAERDERE
- ▶ Daniel BODSON

Research Field and Subjects

The objective of the research is to contribute to identifying new principles of forest planning with a view to meeting the changes in terms of social demands. The approach is twofold: conceptual upstream and methodological downstream.

Research focuses on social forestry, governance, and links between politics and communication.

Representative References

- ▶ C. FARCY, B. DE TERWANGNE AND P. BLEROT. *A distributed information system for public forest and wildlife management in the Walloon Region (Belgium) using open GIS standards*. Computers and electronics in agriculture, 47: 207-220, **2005**.
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- ▶ M. CORNELIS, J.T CORNELIS. *Public debate, collective learning process and soil-plant system expertise: When scientific knowledge become socially distributed*. Paper presented at the international conference Change in Governance as Collective Learning Process. Management, Politics, and Ethics in Forestry, Nancy, **21-24 june 2009**.

Funding

Service Public de Wallonie (D GARNE)
Commissariat Général au Tourisme

Partnership

- ▶ AgroParisTech (Clermont-Ferrand – Paris – Nancy, France)
- ▶ Département de la Nature et des Forêts (DNF/SPW – Région wallonne)
- ▶ Ecole Nationale Forestière d'Ingénieur (ENFI - Maroc)
- ▶ Ecole Nationale Supérieure (Paris - France)
- ▶ ECOFOR (Paris - France)
- ▶ FORPLAN – Forest Planning (Cost pre-proposal)
- ▶ FORSYS - Forest Management Decision Support Systems (Cost)
- ▶ GHFF (Groupe d'Histoire des Forêts Françaises)
- ▶ GRFN&S (Groupe Forêt, nature & Société)
- ▶ Institut Polytechnique LaSalle (Beauvais (France))
- ▶ Université de Liège
- ▶ Université de Ljubljana (Slovénie)

KEY WORDS

Forest planning
Goods and services
Governance
Innovation
Interdisciplinary

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Forest and wood land management in Mediterranean and tropical zones

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- ▶ Caroline VINCKE

Research Field and Subjects

The general objective is to understand the dynamics and improve the management of forest ecosystems and woody vegetation in semi-arid and tropical ecosystems. These ecosystems are often exposed to climate constraints and/or anthropogenic pressure, which can induce some level of degradation and loss of resilience. To better manage these systems is possible provided the way they work is fully understood. Use is being made of various approaches: *in situ* monitoring and manipulation of ecosystems, ecosystem characterization, phytoecological database. The main disciplines are related to forest ecology, forest planning, silviculture.

Products and Services

- ▶ Phytoecological data base
- ▶ Forest planning exploratory tools

Representative References

- ▶ S. IBOUKASSENE. *Dynamique de la végétation des forêts à Quercus suber anthropisées du Nord-Est de l'Algérie (Parc National d'El-Kala)*. Thèse UCL, **2008**.
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- ▶ C. VINCKE, I. DIEDHIOU AND M. GROUZIS. *Long term dynamics and structure of woody vegetation in the Ferlo (Senegal)*. *Journal of Arid Environments*, **2009 (à paraître)**.

Funding

- ▶ Service Public de Wallonie (D GARNE)
- ▶ Wallonie-Bruxelles International
- ▶ Communauté française de Belgique
- ▶ Service public fédéral Affaires étrangères, Commerce extérieur et Coopération au Développement (CUD)
- ▶ Université de Liège
- ▶ Institut National d'Agronomie (Algérie)
- ▶ Centre de Recherche Forestière (Maroc)
- ▶ Institut National de Recherche en Génie Rural et Eaux et Forêts (Tunisie)

Partnership

- ▶ Institut National de la Recherche Forestière (INRF, Algérie)
- ▶ Ecole Nationale Forestière d'Ingénieurs de Sale (ENFI, Maroc)
- ▶ Haut Commissariat aux Eaux et Forêts et à la Lutte contre la Désertification (Maroc)
- ▶ Département de la Nature et des Forêts (DNF)
- ▶ Université Libre de Bruxelles (ULB)
- ▶ Université de Kisangani (UNIKIS, RDC)

KEY WORDS

Ecosystem dynamics
Silviculture
Ecology
Agro-sylvo-pastoralism

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Groundwater reservoir characterisation

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Research Field and Subjects

Groundwater consists, after the ice, of the second reservoir of fresh water. In the Walloon Region of Belgium, groundwater provides more than 80% of the domestic water supply. According to the climatic change predictions, water resources will be reduced and so groundwater will mostly be more and more exploited. This could lead to various problems as the quality of the surface water. This situation shows that it is necessary to assess the quantity and the quality of the groundwater resources and to study interactions between groundwater and surface water. The department of geology has a huge experience in groundwater reservoir characterisation using various techniques as geological and hydrogeological mapping using GIS, surface or groundwater water tracer tests, geophysical prospecting and groundwater modelling.

Representative References

- ▶ B. LOUCHE, V. HALLET. *Influence de la structure tectonique de l'aquifère crayeux du littoral Nord Pas de Calais sur la répartition d'eau salée*. Revue des Sciences de l'Eau 14/3, pp 265-280, **2001**.
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- ▶ BONNIVER, C. FLAMEN, J.P. DESCY, V. HALLET. *Transfer time in karstic media and biodiversity : Han-sur-Lesse case study (Belgium)*. Revue des Sciences de l'Eau Submitted paper, **2009**.
- ▶ D. LEMADEC, P. NOGAREDE, V. HALLET *Investigation of ground and surface water interactions in the Viroin valley, using baseflow and hydrochemical parameters*. Geologica belgica (submitted paper), **2009**.

Funding

- ▶ University of Namur
- ▶ BNB
- ▶ SPW (DGARNE)
- ▶ SPGE
- ▶ FGRC
- ▶ Private funds

Partnership

- ▶ ULg – Département GEOMAC – Faculté des Sciences appliquées
- ▶ FPMS – Cellule d'hydrogéologie – Faculté de Sciences appliquées
- ▶ FPMS – Cellule hydrogéologie – Faculté des sciences appliquées
- ▶ UCL – Département MILA – Faculté d'Ingénierie biologique
- ▶ Département MILA - Faculté d'Ingénierie biologique
- ▶ UCL – Unité MECA
- ▶ UCL – Département de géographie
- ▶ Département des Sciences de la Terre et de l'Environnement
- ▶ Prof. A. DEGRÉ – FUSAGx – Unité d'hydrologie et d'hydraulique agricole
- ▶ Laboratoire de géopédologie
- ▶ France - Université de Calais – Département de géologie.
- ▶ France - Université de Nancy – Centre de recherches pétrographiques et géochimiques
- ▶ Dr. P WALPOLE – Philippines - Ateneo de Manilla University – Environmental Science for Social Change

- ▶ Dr. C. VILLANUEVA – Philippines – University of Saint La Salle – Bacolod.
- ▶ Dr. SURONO – Indonesia – Directorate of Volcanology and Geological hazard Mitigation – Bandung
- ▶ Prof. G. HAKIZA – Burundi – Département de géologie. Université du Burundi.
- ▶ Prof. L. NDUNGO – RD Congo – Faculté d’agronomie – Université Catholique du Graben.
- ▶ Prof. H. NIGUSSIE – Ethiopia – Bureau of water resource development – University of Mekele.

KEY WORDS

Geology
 Hydrogeology
 Tracer test
 Electrical tomography
 Groundwater
 Karst
 GIS groundwater mapping

WEB SITE

<http://www.fundp.ac.be/facultes/sciences/departements/geologie>

Main Equipment

- ▶ Electrical tomography (CAMPUS Tiger – 64 channels)
- ▶ Seismic instrument GEOMETRICS ES 3000
- ▶ Field fluorimeters
- ▶ Automatic samplers
- ▶ Multiparameters probes
- ▶ Pressure and T° probes

Products and Services

Research and expertise in:

- ▶ Geophysical prospecting
- ▶ Groundwater resources mapping, assessment and management
- ▶ Aquifer characterization
- ▶ Tracer tests
- ▶ Groundwater modelling
- ▶ GIS groundwater mapping

Nature reserve analysis

SENIOR SCIENTIST:

► Bertrand HAMAIDE

Research Field and Subjects

Over the last three decades nature reserve selection or the selection of land parcels to set aside as nature reserves so as to enhance biodiversity has been a research focus for quantitative biology. In fact, this type of analysis parallels the field of location science analysis (a branch of operations research). More recently economists came into the picture to propose a cost-efficient nature reserve selection.

The field was further developed by adding spatial constraints and requiring reserves to be spatially coherent.

This research field of nature reserve selection and design is aimed at selecting land parcels to protect species, taking into consideration economic, biological and spatial constraints.

KEY WORDS

Programming
Covering models
Nature reserve selection
Spatial analysis

SENIOR SCIENTIST

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Representative References

- B. HAMAIDE, C. REVELLE AND S. MALCOLM. *Biological Reserves, Rare Species and the Tradeoff Between Species Abundance and Species Diversity*. Ecological Economics, Vol.56, nr.4, p.570-583, **2006**.
- B. HAMAIDE, J. SHEERIN AND C. TINGSABADH. *Nature Reserve Selection for Endangered Species Considering Habitat Needs: The Case of Thailand*, in C. C. Pertsova (Ed.) *Ecological Economics Research Trends*. Nova Science Publishers, Chapter 10, pages 207-229, **2008**.
- B. HAMAIDE. *Biodiversité et réserves naturelles, croisement entre les analyses biologiques, mathématiques et économiques* in C. EBERHARD ed. *Traduire nos responsabilités planétaires. Recomposer nos paysages juridiques*. Bruylant Academia, Brussels, p.547-565, **2008**.
- B. HAMAIDE, J. WILLIAMS AND C. REVELLE. *Cost-Efficient Reserve Site Selection Favoring Persistence of Threatened and Endangered Species*. Geographical Analysis, vol 41, 66-84, **2009**.

Ecology of interactions and biological control

SENIOR SCIENTIST:

- ▶ Thierry HANCE
- ▶ Audrey AYRINAC
- ▶ Hervé COLINET
- ▶ David DAMIENS
- ▶ Isabelle FRÈRE
- ▶ Anne-Catherine MAILLEUX
- ▶ Frédéric MURATORI
- ▶ Christophe SALIN

Research Field and Subjects

The primary aim of the research is to explore how species interact at the population level. This includes the analysis of behaviour population genetics and chemical ecology in an evolutionary perspective. On applied aspects, a research program is being developed, which deals with biocontrol of insect pest and global change. The main models are:

- 1) Biodiversity analyses in the tropical forest of Panama, mainly on trophic interaction between plant-insect and parasitoids.
- 2) Mosquito distribution and survey in Belgium. Invasive species and adaptation to temperature.
- 3) Host-parasitoid interaction, coevolution, behaviour and reproductive strategy.
- 4) Analyses of subsocial organisation of mites (Acari) and Aphids.
- 5) Biocontrol of aphids using parasitoids.
- 6) Dust mite control.
- 7) Physiology of nutrition and artificial rearing of Aphids.
- 8) Estimate of invasive species pest.

Representative References

- ▶ M. CUIGNET, T. HANCE, D. M. WINDSOR. *The cophylogenetic history of the association between neotropical Cassidinae (Chrysomelidae: Cassidinae) and their egg parasitoid (Hymenoptera: Eulophidae)*. Molecular phylogenetics and Evolution 42 (3) 573-584 **2006**.
- ▶ MURATORI F., DAMIENS, D., HANCE, T., and BOVIN G. 2008. Bad housekeeping: why do aphids leave their exuviae inside the colony? *BMC Evolutionary Biology* 2008, 8:338 – 345.
- ▶ T. HANCE, J. VAN BAAREN J., P. VERNON, G. BOVIN. *Impact of extreme temperatures on parasitoids in a climate change perspective*. Annual review of Entomology, 52, 107-126, **2007**.
- ▶ D. STILMANT, C. VAN BELLINGHEN, T. HANCE, G. BOVIN. *Host specialization in habitat specialists and generalists* Oecologia, 156 (4), 905-912, **2008**.

- ▶ A. DESCAMPE, C. MESKENS, J. PASTEELS, T. HANCE. *Potential and realized feeding niches of neotropical hispine beetles (Chrysomelidae: Cassidinae, Cephaloleiini)*. Environmental Entomology 37 (1), 224-229, **2008**.

Patents

- TH. HANCE., M. DEBATTY-MESTDAGH, V. CAMBIER, C. BOEGEN, F. MURATORI, O. LEBBE, A.M. DOS SANTOS GONCALVES, **2001**.
Hydrogel beads or capsules as artificial media for insect ovidposition and rearing of endoparasitoid. 018701134-2-2313

Awards

- Price Adolphe Wetrens 2001, Académie Royale des Sciences, des Lettres et des Beaux-art, Belgium

Funding

- ▶ FNRS
- ▶ FSR
- ▶ Walloon Region
- ▶ Belspo
- ▶ Private company

Partnership

- ▶ Agriculture Canada and McGill University, Laboratory of parasitoid behaviour analyses
- ▶ Collaboration CNRS-FNRS, Université de Rennes 1,
- ▶ Smithsonian Tropical Research Institute, Republica de Panama;
- ▶ Université de Rennes I
- ▶ ICAS (Institut de recherche forestière), Romania, Defoliator insect outbreaks

Main Equipment

Insectarium, Olfactometry, behavioral analyses, flux cytometry

Products and Services

- ▶ Biocontrol application
- ▶ Pest risk assessment

KEY WORDS

Insects
Population biology
Host-parasitoids
Biological control
Mosquitos
Pest risk assessment
Food web
Trophic systems
Global warming
Physiology of extreme temperatures

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Environmental Pressure and Response

SENIOR SCIENTIST:

▶ Alain HOLEYMAN

Research Field and Subjects

The research focuses on the study of the migration of solute pollutants within saturated and unsaturated soils, and the relation between soil use and aquifer contamination.

The other investigated subjects pertain to:

- the characterization of heterogeneous soils with special reference to the identification of preferential pathways, resorting to the combined utilization of data generated by exploratory drilling, pumping tests, and tracer tests;
- the propagation of vibration and mechanical waves in soil with special reference to soil degradation and liquefaction upon cyclic loading, and its application to the performance assessment of vibration-free foundations.

Representative References

- ▶ H. GONIN, A. HOLEYMAN and F. ROCHER-LACOSTE (Eds.), *TRANSVIB 2006: Vibratory Pile Driving and Deep Soil Compaction*, Laboratoire Central des Ponts et Chaussées, Paris, ISBN 2-7208-2466-6, 400 p, **2006**.
- ▶ C.C. FRIPPIAT, P. CONDE PÉREZ and A.E. HOLEYMAN, Estimation of laboratory-scale dispersivities using an annulus-and-core device, *Journal of Hydrology* 362, 57-68, **2008**.
- ▶ C.C. FRIPPIAT and A.E. HOLEYMAN, A comparative review of upscaling methods for solute transport in heterogeneous media, *Journal of Hydrology* 362, 150-176, **2008**.
- ▶ T. SAKAKI, C.C. FRIPPIAT, M. KOMATSU and T.H. ILLANGASEKARE, On the value of lithofacies data for improving groundwater flow model accuracy in a three-dimensional laboratory-scale synthetic aquifer, *Water Resources Research*, 45, W11404, doi:10.1029/2008WR 007229, **2009**.
- ▶ H. MASOUMI, G. DEGRANDE and A. HOLEYMAN, Pile response and free field vibrations due to low-strain dynamic loading, *Soil Dynamics and Earthquake Engineering*, Vol.29, 5, 834-844, **2009**.
- ▶ C.C. FRIPPIAT, T.H. ILLANGASEKARE and G.A. ZYVOLOSKI, Anisotropic effective medium solutions of head and velocity variance to quantify flow connectivity, *Advances in Water Resources* 32, 239-249, **2009**.

Awards

- ▶ "ICE 10th Anniversary Competition" for an innovative enhancement of the vibro-compaction technique of soils at depth
- ▶ "E. De Beer Award" for contributions to the advancement of knowledge in geotechnical engineering
- ▶ "Jacques Verdeyen Soil Mechanics Award" for research in pile dynamics.

Funding

- ▶ EU
- ▶ Ministry of Economic Affairs

Partnership

- ▶ CSTC: Centre Scientifique et Technique de la Construction, Belgique
- ▶ LCPC: Laboratoire des Ponts et Chaussées, France
- ▶ Institut Navier, France
- ▶ RW : DGRNE
- ▶ FUSAGx, Belgique
- ▶ Colorado School of Mines, Colorado, USA.

Products and Services

- ▶ Numerical modelling of solute transport in soils and aquifers (MODFLOW, MT3DMS, etc.)
- ▶ Numerical modelling of coupled transport processes in soils (water, air, heat, etc.).
- ▶ Performance and interpretation of pumping tests and tracer tests in the field.
- ▶ Highlighting of scale effects on dispersion within the framework of studying the transport of solutes.
- ▶ Highlighting of factors influencing wave propagations as a result of construction processes; soil-structure interaction.
- ▶ Evaluation of the performance of deep foundations by dynamic methods.

Main Equipment & Specific Tools

Undisturbed samples, meter-scale laboratory models for remoulded soils, monitoring wells ; this equipment is used to study water and solute migration at several scales under prescribed boundary conditions.

Plexiglas model to visualize underground water flow, including non-aqueous phase liquids (NAPL).

Permeameter, breakthrough columns for the determination of solute longitudinal and transverse dispersion parameters within soils at the decimetric scale.

Dynamic loading test module, for the evaluation of the performance of deep foundations.

KEY WORDS

Groundwater contamination
Dispersion of pollutants
Soil dynamics
Scale effect
Pumping test
Tracer test
Sol-structure interaction
Geo-environmental characterization
Vibrations

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Vegetation dynamics in semi-natural open habitats and in forests

SENIOR SCIENTISTS:

- ▶ Anne-Laure JACQUEMART
- ▶ Quentin PONETTE
- ▶ Caroline VINCKE

Research Field and Subjects

The general objective of this research is to analyze the vegetation (phytosociology) and to assess its dynamics (fruit set, seed rain, dispersal, seed bank, germination, growth and survival), with relation with climate and soil controllers when necessary or possible. A special focus is given to vegetation in semi-natural open habitats and in forests. Those approaches allow to elaborate:

- 1) Predictive analysis of invasion of habitats for invasive alien plant species;
- 2) Monitoring for restoration and management in protected areas;
- 3) Regeneration plans;
- 4) Species vulnerability to soil and/or water constraints, during the establishment phase for woody plants and as part of the understory for other species.

Representative References

- ▶ T. DEGEN, F. DEVILLEZ, A.L JACQUEMART. *Gaps promote plant diversity in beech forests (Luzulo-Fagetum), North Vosges, France*. Ann. For. Science, 62, 429-440, **2005**.
- ▶ M. PAIRON, O. CHABRERIE, C. MAINER CASADO, A-L JACQUEMART. *Sexual regeneration traits linked to black cherry (Prunus serotina Ehrh.) invasiveness*. Acta Oecologica, 30, 238-247, **2006**.
- ▶ M. PAIRON, A. VERVOORT, A-L JACQUEMART. *Fiche technique : Le cerisier tardif (Prunus serotina Ehrh.) Ecologie et gestion de cette espèce envahissante*. Silvia Belgica, 4, 55-57, **2006**.
- ▶ M. PAIRON, A. VERVOORT, A-L JACQUEMART. *Le cerisier tardif (Prunus serotina Ehrh.). Biologie et moyens de lutte*. Forêt wallonne, 86, 22-31, **2006**.
- ▶ A. VERVOORT, A.L JACQUEMART. *La problématique des espèces envahissantes. Une approche concrète par l'exemple des balsamines*. Forêt wallonne, 91, 10-17, **2007**.
- ▶ A.L JACQUEMART, J.R DE SLOOVER. *Effets de l'étrépage pour la restauration des landes tourbeuses en haute Ardenne belge*. Acta Botanica Gallica, 155: 133-141, **2008**.

- ▶ A.L JACQUEMART, A. ANGENOT, J.R DE SLOOVER, I. ISERENTANT et collaborateurs. *La Réserve Naturelle Domaniale du plateau des Tailles. Approches géographique, historique et biologique*. Glain et Salm, 130 pp. **2008**.
- ▶ VINCKE C., DIEDHIOU I., M. GROUZIS. *Long term dynamics and structure of woody vegetation in the Ferlo (Senegal)*, Journal of Arid Environments, **2009**.

Products and Services

- ▶ Vegetation relevés (statement), seed banks, multivariate analyses, germination tests, dispersal modelling, all items for exhibition about bog biology and conservation
- ▶ Environmental monitoring: instrumented permanent plots, data mining and reporting
- ▶ Image analyses of plant samples

Main Equipment

- ▶ Seed traps, germination chambers, vegetation analysis softwares
- ▶ Environmental monitoring: automated meteorological station; soil temperature and soil water content probes; rainfall, stemflow and throughfall automated collectors; lysimeters; sap flow sensors; dendrometers; portable infrared gas monitor and soil respiration chamber; LAI 2000; hemispherical photography; assimilation and transpiration chamber adapted for herbaceous layer in forest; plant samples image analysis.

Awards

- ▶ Prix Jean Lebrun, Académie royale des Sciences de Belgique, 2000, to A.L JACQUEMART.

Partnership

- ▶ Département d'étude du milieu naturel et agricoles (DEMNA, Gembloux)
- ▶ Biodiversity platform, Belgium
- ▶ ULB, ULG, UMH, VUB, UIA, UGhent
- ▶ Jardin Botanique National, Meise
- ▶ Université Nancy, Lille-1, Lausanne, Leiden, Montpellier, Charleston

KEY WORDS

Vegetation
Reproductive success
Dispersal
Seed banks
Invasive plant species
Bogs
Heathlands
Restoration
Forest regeneration
Drought resistance in forest

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WEB SITE

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Water and nutrient fluxes through soil, and plants

SENIOR SCIENTISTS:

- ▶ Mathieu JAVAUX
- ▶ Xavier DRAYE
- ▶ Marnik VANCLOOSTER

Research Field and Subjects

Understanding water and nutrient fluxes through soils and plants is important to sustain and increase the world food production without damaging environmental resources. The research group investigates the fluxes through the soil-plant-atmosphere *continuum* to support hydrological and agronomical studies. Study of plant water demand relationships, irrigation, and abiotic stress (water stress, saline stress, nutrient stress) on crop development and root extraction processes are also undertaken. The group develops soil-plant-atmosphere models at the scale of the root system and agricultural field plot to predict water and nutrient fluxes, plant growth and plant yield.

Representative References

- ▶ M. VAN DER VELDE, S. GREEN, M. VANCLOOSTER. *Transpiration of squash under a tropical maritime climate*. Plant and Soil, 280, p. 323-337, **2006**.
- ▶ A.J TEULING, R. UJLENHOET, F. HUPET, P.A TROCH. *Impact of plant water uptake strategy on soil moisture and evapotranspiration dynamics during drydown*. Geoph. Res. Letters, 34, p. doi: 10.1029/2005GL25019, **2006**.
- ▶ D. FATONDJI, C. MARTIUS, C. BIELDERS, P.L.G VLEK, A. BATIONO, B. GÉRARD. *Effect of planting technique and amendment type on pearl millet yield, nutrient uptake, and water use on degraded land in Niger*. Nutrient Cycling in Agroecosystems. 76, p. 203-217. **2006**.
- ▶ S. DE DORLODOT, B. FORSTER, L. PAGÈS., A. PRICE, R. TUBEROSA, X. DRAYE, *Root system architecture : opportunities and constraints for genetic improvement of crops*, Trends in Plant Science, 12, 10, p. 474-481. **2007**.
- ▶ M. JAVAUX, T. SCHROEDER, J. VANDERBORGHT, AND H. VERECKEN. *Use of a three-dimensional detailed modelling approach for predicting root water uptake*. Vadose Zone Journal 7:1079–1088 doi : 10.2136/vzj2007.0115, **2008**.
- ▶ T. SCHRÖDER, L. TANG, M. JAVAUX, J. VANDERBORGHT, B. KORFGEN, AND H. VERECKEN. *A grid refinement approach for a 3D soil-root water transfer model*. Water Resour. Res. 45, W10412, doi:10.1029/2009WR007873, **2009**.

Products and Services

Facilitator for providing data of the agro-meteorological network in the Région Wallonne, in particular data from the PAMESEB.

Main Equipment

- Electronics and information technology for logging, analysis, storage and presentation of water and soil related data (data logging equipment, telemonitoring equipment, advanced software (geographical information systems, data base management systems).)
- Agro-meteorological equipment. Equipment for the measurement of meteorological variables (rainfall, solar radiation, wind speed and direction)
- Weighable lysimeter for studying the in-situ water balance
- The WAVE model: Model for water and chemical transport in soil and vadoze environments for calculating pressures on groundwater bodies, but also for the crop production and variables related to the bio-geochemical cycles of soils.

KEY WORDS

Soil
Abiotic stress
Water
Saline
Nutrients
Crop development
Root

SENIOR SCIENTIST

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Forest ecosystem functioning and silviculture

SENIOR SCIENTISTS:

- ▶ Mathieu JONARD
- ▶ Quentin PONETTE
- ▶ Caroline VINCKE

Research Field and Subjects

The general objective of this research is to understand the reactivity of forest ecosystems, stands and trees to resources (e.g. carbon, nutrients, water) and/or controllers (e.g. light, water), using an ecosystem approach.

Reactivity of stands and trees is assessed through growth, mortality or health condition, and regeneration; input–output budgets are assessed at the ecosystem level.

Resources and controllers may be imposed by the site or result from selected silvicultural options such as species composition (including species mixture), stand density, fertilizing, and biomass harvesting.

Use is being made of various approaches: *in situ* monitoring and manipulation of ecosystems, studies in controlled conditions, ecosystem characterization, process identification, modelling. The main disciplines are related to forest ecophysiology and ecology.

From an applied perspective diagnostic or decision support tools such as stand or site typologies and understorey light measurement methods are developed. A special emphasis is also given to devise silvicultural prescriptions integrating ecological, technical and economical aspects.

Representative References

- ▶ C. VINCKE AND B. DELVAUX. *Porosity and available water of temporarily waterlogged soils in a Quercus robur (L.) declining stand*. Plant and Soil, 271: 189-203, **2005**.
- ▶ C. VINCKE, A. GRANIER, N. BRÉDA AND F. DEVILLEZ. *Evapotranspiration of a declining Quercus robur (L.) stand from 1999 to 2001. II. Daily actual evapotranspiration and soil water reserve*. Annals of Forest Science, 62: 615-623, **2005**.
- ▶ M. JONARD, F. ANDRÉ AND Q. PONETTE. *Modeling leaf dispersal in mixed hardwood forests using a ballistic approach*. Ecology, 87: 2306–2318, **2006**.
- ▶ M. JONARD, L. MISSON AND Q. PONETTE. *Long-term thinning effects on the forest floor and the foliar nutrient status of Norway spruce stands in the Belgian Ardennes*. Canadian Journal of Forest Research, 36: 2684–2695, **2006**.

- ▶ M. JONARD, F. ANDRÉ, F. JONARD, N. MOUTON, P. PROCÈS AND Q. PONETTE. *Soil carbon dioxide efflux in pure and mixed stands of oak and beech*. Annals of Forest Science, 64: 1–9, **2007**.
- ▶ F. ANDRÉ, M. JONARD AND Q. PONETTE. *Influence of meteorological factors and polluting environment on rain chemistry and wet deposition in a rural area near Chimay, Belgium*. Atmospheric Environment, 41: 1426–1439, **2007**.
- ▶ J.-B. WAUTERS, S. COUDERT, E. GRALLIEN, M. JONARD AND Q. PONETTE. *Carbon stock in rubber tree plantations in Western Ghana and Mato Grosso (Brazil)*. Forest Ecology and Management, 255 (7): 2347-2361, **2008**.
- ▶ C. VINCKE AND Y. THIRY. *Water table is a relevant source for water uptake by a Scots pine (Pinus sylvestris L.) stand: Evidences from continuous evapotranspiration and water table monitoring*. Agricultural and Forest Meteorology, 148: 1419-1432, **2008**.

Funding

- ▶ Service Public de Wallonie, DGARNE, DNF
- ▶ Institut Bruxellois pour la Gestion de l'Environnement (IBGE)
- ▶ European Union (Interreg)
- ▶ Belgian Science Policy

Partnership

- ▶ Département de la Nature et des Forêts (DNF)
- ▶ Département d'étude du milieu naturel et agricole (DEMNA)
- ▶ FUSAGx, Unité de Physique des bio-systèmes
- ▶ INRA-Nancy: Biogéochimie des écosystèmes forestiers; Bioclimatologie et écophysiole; Croissance et production; Phytoécologie forestière
- ▶ INRA-Bordeaux: unité Ecologie fonctionnelle et physique de l'environnement; Unité Mixte de Recherches 'Transfert sol-plante et cycle des éléments minéraux dans les écosystèmes cultivés'
- ▶ KUL, Afdeling Bos, Natuur en Landschap
- ▶ RUG, Department of Forest and Water Management; Laboratory of Forestry
- ▶ SCK-CEN, Biosphere Impact Studies
- ▶ ULB, Laboratoire de Lutte Biologique et Ecologie Spatiale
- ▶ ULG, Dpt of Environmental Sciences and Management, Laboratory of Plant and Microbial Ecology, Institute of Botany

Main Equipment

- ▶ Environmental monitoring: automated meteorological station; soil temperature and soil water content probes; rainfall, stemflow and throughfall automated collectors; lysimeters; sap flow sensors; dendrometers; portable infrared gas monitor and soil respiration chamber; LAI 2000; hemispherical photography
- ▶ Mineral analyses of plant, water, and soil samples: microwave digestion, HPLC, ICP, C&N analyzer

Products and Services

- ▶ Environmental monitoring: instrumented permanent plots, data mining and reporting
- ▶ Mineral analyses: plant (including woody tissues), water, and soil samples
- ▶ Image analyses of plant samples

KEY WORDS

Environmental monitoring
Forest stand dynamics
Silviculture
Water and nutrient constraints
Cycling
Ecophysiology

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Hydrogeophysics and modelling for solving hydrogeological problems (flooding, soil contamination, erosion...)

SENIOR SCIENTISTS:

- ▶ Sebastien LAMBOT
- ▶ Marnik VANCLOOSTER
- ▶ Mathieu JAVAUX

Research Field and Subjects

The imaging, characterization and monitoring of soil and sub-soil physical properties by means of geophysical (ERT, TDR, FDR) and nearby remote sensing (GPR, EMI) techniques, in particular in relation to hydraulic functioning of soil and subsoil systems, as a support to environmental and agronomical engineering.

The development of advanced assessment techniques, characterised by a high spatial and temporal resolution.

The modelling of wave propagation in soil of ground penetrating radars.

Representative References

- ▶ S. LAMBOT, M. ANTOINE, M. VANCLOOSTER, E.C SLOB, *Effect of soil roughness on the inversion of off-ground monostatic GPR signal for non-invasive quantification of soil properties*. Water Resources Research, 42, W03403, p. doi: 10.1029/2005WR004416. (Publié, Scientifique - portée internationale), **2006**.
- ▶ O. LOPERA, N. MILISAVLJEVIC, S. LAMBOT, *Clutter reduction in GPR measurements for detecting shallow buried landmines: a Colombian case study*. Near Surface Geophysics, 5, 1, p. 57-64. (Publié, Scientifique - portée internationale), **2007**.
- ▶ S. LAMBOT, A. GORRITI, *Foreword of the Special Issue of Near Surface Geophysics on Advanced GPR* (contains 7 papers presented at the IWAPGR 2005, Univers.Delft). Near Surface Geophysics, 5, 1, p. 3-4, **2007**.
- ▶ O. LOPERA, E.C SLOB, N. MILISAVLJEVIC, S. LAMBOT, *Filtering Soil Surface and Antenna Effects From GPR Data to Enhance Landmine Detection*. IEEE Transactions on Geoscience and remote sensing, 45, 3, p. 707-717, **2007**.
- ▶ A. BESSON, M. JAVAUX, B. VANDOORNE, C. BIELDERS, M. VANCLOOSTER, *Caractérisation des hétérogénéités structurales du sol par tomographies de résistivité électrique 3D à l'échelle de colonnes issues d'agroécosystèmes conventionnel et simplifié*. JNES, **2009**.

Products and Services

- ▶ Expertise in hydrogeophysics and modelling for solving hydrological problems (flooding, soil contamination, erosion, irrigation design, etc...)

Main Equipment

- ▶ Hydrogeophysical material: GPR (portable VNA portable, fixed VNA), EMI, ERT (Syscal-Pro, 196 electrodes + switch box), TDR (TDR100+ multiplexing systems Campbell).
- ▶ Soil simulator for the study of wave propagation of GPR and EMI signals in soil

KEY WORDS

Soil imaging tomography
Hydrogeophysics
Ground penetrating radar
Flooding
Contamination
Erosion

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Study of atmospheric pollutants by lasers

SENIOR SCIENTISTS:

- ▶ Muriel LEPÈRE
- ▶ Nikolay SANZHAROV

Research Field and Subjects

The research focuses on the study of atmospheric pollutants using lasers, especially gases (hydrocarbons such as methane, carbon dioxide ...) between atmospheric temperature and high temperature (several hundreds of degrees) and atmospheric clusters (based on carbon and hydrocarbons). The research also explores the interactions between clusters and gases.

Representative References

- ▶ M. LEPÈRE, A. VALENTIN, A. HENRY, C. CAMY-PEYRET, M. LENGELÉ, J.C. POPULAIRE, G. BLANQUET. *Diode-laser spectroscopy: Temperature dependence of R(0) line in the ν_4 band of CH_4 perturbed by N_2 and O_2* . J. Mol. Spectrosc. 233, 86-92, **2005**.
- ▶ S. ROBERT, M. HERMAN, J. VANDER AUWERA, G. DI LONARDO, L. FUSINA, G. BLANQUET, M. LEPÈRE, A. FAYT. *The bending vibrations in $^{12}C_2H_2$: Global vibration-rotation analysis*. Mol. Phys. 105, 587-596, **2007**.
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- ▶ B. MARTIN, M. LEPÈRE. *O_2 - and air-broadening coefficients in the ν_4 band of $^{12}CH_4$ at room temperature*. J. Mol. Spectrosc., **2009**.

Funding

- ▶ FUNDP
- ▶ F.R.S.- FNRS
- ▶ PNCA du CNES (CNRS, France)

Partnership

- ▶ Institut UTINAM, Université de France Comté, Besançon, France.
- ▶ Service de Chimie Quantique et de Photophysique, Université Libre de Bruxelles, Belgique
- ▶ LPMAA, Université P. et M. Curie, Paris, France
- ▶ Department of Physics, Astronomy and geophysics, Connecticut College, New London, USA
- ▶ LPMAA, Université P. et M. Curie, Paris, France

Main Equipment

Diode-laser spectrometers and different absorption cells allowing measurements at low and high temperatures

KEY WORDS

Pollution
Lasers
Gases
Atmospheric clusters

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Evolutionary mechanisms for reproductive isolation and species diversification

SENIOR SCIENTIST:

► Caroline NIEBERDING

Research Field and Subjects

A major open issue in Evolutionary Biology is understanding how the past and current species diversity has appeared on Earth. Genetic differentiation between populations can cause reproductive isolation and ultimately lead to the emergence of new species, i.e. speciation. The research is aimed at testing the relative importance of genetic drift versus selection in shaping genetic differentiation between populations through evolutionary time.

This question is addressed testing different candidate adaptive traits in several biological systems:

1. Evolution of male sex pheromones in butterflies;
2. Evolution of life history traits in host-parasite interactions in rodents and nematodes;
3. Evolution of dispersal and of host specialization in spider mites.

1. Sex pheromones are, from arthropods to mammals, essential chemical mediators of communication between males and females. As such they are potentially involved in adaptive evolution and reproductive isolation between species. The main question here is to test whether sexual selection on the production of male sex pheromones is responsible for reproductive isolation and species diversification in the butterfly genus *Bicyclus*. Phylogenetic, behavioural and genetical approaches are combined. The research is particularly aiming at relating changes (mutations or variation in gene expression) in candidate genes involved in pheromone production to differences between the pheromones of different *Bicyclus* species and populations and link the changes to their diversification history. This will allow association of the phenotypic variation in pheromone production with the genetic bases generating this variability and the consequences of this variability on reproductive isolation.

2. Several parasite and host life history traits, including life cycle, mode of transmission, dispersal, level of specificity and abundance, shape the differentiation of parasite populations and can lead to reproductive isolation and speciation in parasites. Currently a statistical approach is being developed, which is aiming at specifying the relative importance of various parasite and host life history traits in shaping congruent or incongruent population structures. Another objective is to evaluate the role of spatial and temporal variations of these host and parasite

traits across their distribution range in determining long-term common differentiation of host and parasite populations.

3. Dispersal affects the distribution of genetic diversity among populations and therefore plays a part in their genetic differentiation. Mathematical models have theoretically predicted how joint evolution of dispersal and local adaptation, such as habitat specialization, can engender new races and lead to reproductive isolation. Here the aim is testing the validity of these models predictions using artificial selection in a lab-designed controlled environment. The activity of several candidate genes will also be tested for their role in dispersal and, where relevant, estimate the number of loci involved in dispersal behaviour. The importance of dispersal in determining the spread of the two-spotter spider mite *Tetranychus urticae* Koch, model species of this research project, in greenhouses, will also be tested. As a pest of many cultivated plants, *T. urticae* is indeed an herbivorous mite of huge economical importance. It is expected that a better understanding of the patterns of dispersal of mites in relation with habitat specialization may suggest ways of modifying the agroecosystem to reduce mite populations and concurrent use of pesticides.

Representative References

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- *Fonds pour la Recherche Fondamentale Concertée (FRFC)*
- Research grants for research missions in Cameroun, Uganda and the Netherlands, and for attending conferences, from Leopold III fund and FNRS

Partnership

- Montpellier Université
- Leiden University
- Paris VI Université
- CBGP, Montpellier Université
- Lund University
- Sundsvall University
- Greifswald University
- Gembloux Université
- Leiden University
- Liège Université

Main Equipment

- gas chromatography coupled to electroantennogram and mass spectrometry
- molecular and comparative phylogenetics and phylogeography (methodologies for reconstructing the evolutionary relationships between populations and species), experimental evolution (artificial selection) and genetics (identification of candidate genes, quantitative PCR, transgenics).

KEY WORDS

Evolution
Speciation
Bicyclus, tetranychus
Host-parasite
Chemical ecology
Phylogeny
Phylogeography
Genetics
Sexual selection
Dispersal

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Diversity, ecology, evolution and conservation of European and Mediterranean Orchids

SENIOR SCIENTIST:

► Daniel TYTECA

Research Field and Subjects

Orchids are a rather diversified plant family. They grow in various types of biotopes on most of the terrestrial surfaces, and they maintain close and sophisticated relationships with their partners of the living world. In several respects the research contributes to increasing the knowledge in this field and to conservation of Orchids in Europe and the Mediterranean Basin. Several projects are being developed:

(1) Contribution to the systematic study, classification and phylogenetic reconstruction of European Orchid genera. This focus mainly on complex genera (*Dactylorhiza*, *Ophrys*, *Epipactis*, *Orchis* s.l.). Approaches used include morphology, morphometrics, genetics, molecular phylogeny, and are implemented using data and material collected in the field in various parts of Europe and the Mediterranean Basin.

(2) Study of reproductive success and explanatory factors in some Orchid genera. In this project the differences observed in reproductive success among different taxa and populations of the same taxon are investigated, and the research group attempts to identify potentially explanatory factors, which can be individual, populational, climatic and, most importantly, ecological (influence of pollinating insects). The material and data collected in various parts of Europe are used and the statistical inference software is exploited. The genera investigated so far mainly include *Ophrys* and *Epipactis* but the idea is to study genera such as *Dactylorhiza* and *Platanthera*.

(3) Contribution to the phylogenetic study of *Ophrys*. It is suggested that the phenomenal diversification within deceptive orchids is mainly due to the rather limited reproductive success in those organisms (project N. 2). Thus, genetic drift, accompanied by episodic periods of selection, would be the mechanisms underlying speciation in those orchids. This project aims to (1) the phylogenetic reconstruction of the genus *Ophrys* (identification of the different evolutionary units, and allocation of each morpho-species to one of those units), followed by reconstruction of ancestral states of morphological and ecological characters, in order to identify the factors driving this dra-

matic speciation process; (2) quantify and qualify the changes in reproductive success (within populations and species), in order to determine its importance in the species of the genus *Ophrys* (project N. 2).

(4) Contributions to knowledge, systematics, distribution and conservation of Orchids in Belgium, France and Portugal. The results of the research conducted in the scope of the other projects (1 to 3) contribute to better knowledge of the biology and ecology of species and populations, and thereby, participate in the formulation of the objectives of nature conservation.

Representative References

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Effects of individual and population parameters on reproductive success in three sexually deceptive orchid species. Plant Biology 11: 454-463, **2009**.

Funding

- ▶ UCL
- ▶ FNRS

Partnership

- ▶ Centre de Recherche de la Nature, des Forêts et du Bois (Région Wallonne)
- ▶ Univ. de Liège
- ▶ Instituto Superior de Agronomia (Lisboa)
- ▶ Universidade Lusófona (Lisboa)

KEY WORDS

Orchidaceae, diversity
Ecology
Evolution
Conservation
Phylogenetic reconstruction
Reproductive strategy
Reproductive success
Deception

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Integrated soil and water resources management

SENIOR SCIENTISTS:

- ▶ Marnik VANCLOOSTER
- ▶ Charles BIELDERS

Research Field and Subjects

Soil and water are key natural resources for agricultural development and ecosystem functioning. Sustainable exploitation of these resources implies that management objectives in space and time, across the different compartments of the hydrosphere and pedosphere be taken into consideration. Research in this area is devoted to the characterization and modelling of different soils and water functions and services, in support of the sustainable management of the natural soil and water resources.

- ▶ Integration of the transfer of water, solutes and solids within hydrological entities: watershed, reservoir, groundwater body, region.
- ▶ Design of hydrological database and information systems.
- ▶ Development and application of integrated hydrological models.

Representative References

- ▶ G. PINEROS D. JUAN, A. ORDONEZ, J. ROOSEN, M. VANCLOOSTER. *Meta-modelling: theory, concepts and application to nitrate leaching modelling*; Ecological modelling, 193, 3-4, p. 629-644, **2006**.
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- ▶ K. SEBARI, M. VANCLOOSTER, A. TILMANT. *Optimisation de la gestion conjointe des ressources en eau dans la vallée du Draa (Maroc)*. Congrès GIRE3D, Univers. Cadi Ayyad, Marrakech, Maroc, **23-25 May**.
- ▶ Q. GOOR, E. PERSOONS. *Sustainable water resources management in the irrigated area of the Draa valley (South-Morocco)*. Congrès GIRE3D, Univers. Cadi Ayyad, Marrakech, Maroc, **23-25 May**.
- ▶ N. VAN CAUWENBERGH, D. PINTE, A. TILMANT, M. VANCLOOSTER. *Water management in the Andarax river, Almeria - Part II: decision support system, In: International Conference "El Agua Subterranea en Paisas Mediterraneo"*. AquainMed., Malaga, Spain, April, p. Proceedings, **2006**.

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Products and Services

- ▶ Integrated hydrological modelling studies
- ▶ Optimisation and decision support for sustainable water resources management

Specific tools & Main Equipment

- ▶ Integrated hydrological models
- ▶ Optimisation models for water resources management

Partnership

UNESCO – IHE (Delft)

KEY WORDS

Integrated water resources management
 Optimization of water resources
 Irrigation
 Flood management
 Drought management

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Evolution meets conservation: changing organisms in changing anthropogenic landscapes

SENIOR SCIENTIST:

▶ Hans VAN DYCK

Research Field and Subjects

Human-modified ecosystems are shaped by human activities and their side effects, which are scientifically recognized for hampering the future of biological diversity and ecosystem functions. Habitat fragmentation and climate change have significant ecological effects on the distribution of many organisms. The research group is particularly interested in the mechanisms that lead to such effects and how these impact on animal population persistence.

Focus is set on how animals behaviourally interact with their changing environment. Recent studies on rapid evolution go against accepted wisdom that ecological and evolutionary dynamics would occur at different time scales. A better understanding of evolutionary biology in anthropogenic environments and for a better integration of evolutionary biology – including fields like behavioural ecology and life history theory – into landscape ecology and conservation biology is required.

Research fields include behaviour, life history, functional morphology, thermal ecology and landscape ecology. For some projects eco-physiology, population genetics and quantitative genetics are also covered.

Butterflies are our main study system to address ecological, evolutionary and conservation issues. For conservation questions, holistic, multi-species approaches that take into account evolution are the real challenge for conservation in rapidly changing environments.

Current research can be summarized into the following five fields:

1. Behavioural ecology of animal movements and dispersal;
2. Adaptation in anthropogenic environments;
3. Insect evolutionary ecology and behaviour (including thermal ecology);
4. Resource-based habitat concept and application; and
5. Applied conservation projects and policies.

Representative References

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- ▶ D. MAES, H. VAN DYCK. Habitat quality and biodiversity indicator performances of a threatened butterfly versus a multispecies group for wet heathlands in Belgium. *Biological Conservation* 123: 177-187, **2005**.
- ▶ W. VANREUSEL, H. VAN DYCK. When functional habitat does not match vegetation types: a resource-based approach to map butterfly habitat. *Biological Conservation* 135: 202-211, **2007**.
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Funding

- ▶ UCL
- ▶ FRFC
- ▶ FRIA
- ▶ Région Wallonne
- ▶ European Science Foundation (ESF)

Partnership

- ▶ PROF. C. WIKLUND AND PROF. B. KARLSSON (Stockholm Univ.)
- ▶ PROF. T. SHREEVE AND PROF. C. BREUKER (Oxford Brookes Univ.)
- ▶ PROF. M. BAGUETTE (MNHN, Paris)
- ▶ PROF. J. SETTELE (UFZ, Halle-Leipzig)
- ▶ PROF. D. BONTE (Ghent Univ.)
- ▶ DR. D. MAES (INBO, Brussels)

Specific Tools & Main Equipment

Field studies. Measure of microclimatic conditions (e.g. data loggers) and body temperatures in insects (e.g. thermal probes). Movements tracking by GPS and use of GIS-software (Geographic Information System).

Laboratory studies. Controlled insect breeding experiments in climate rooms to study life history traits, behaviour, morphology (e.g. morphometry by image analysis software) and some physiology (e.g. respirometry). Flight performance is studied by tethered flight experiments and flight tunnel experiments. Behavioural work is also done in outdoor flight cages.

KEY WORDS

Ecology
Evolution
Biodiversity
Animal behaviour
Anthropogenic landscapes
Conservation biology
Thermal biology
Global changes

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Plant evolutionary ecology: understanding plant reproductive strategies and their evolutionary consequences

SENIOR SCIENTIST:

► Renate WESSELINGH

Research Field and Subjects

The work in this laboratory is not directly dedicated to protecting biodiversity, but every bit of knowledge that brings researchers closer to understanding how the natural world functions is most probably useful for protecting species and their environment.

1) Natural hybridization

Since speciation is a gradual process, even clearly defined species can sometimes still cross and produce viable offspring. Natural hybridization in the genus *Rhinanthus* is investigated with a focus on the mechanisms of gene transfer between *Rhinanthus minor* and *R. angustifolius*, especially on the role of the pollinating bumblebees, and on the impacts of this exchange on the patterns of genetic diversity in these two species.

2) Plant flowering strategies

The timing of flowering is of major importance to ensure successful plant reproduction. *Rhinanthus* species are summer annuals and genetically programmed to start producing flowers after a specific number of vegetative nodes, and variation in this number of nodes gives rise to differences in flowering time. Effects of early or late flowering have been investigated, as has been the genetic basis of this regulation mechanism, and what other factors can influence the timing of flowering, such as germination time, have been identified.

3) Ecology of invasive species

Plants that are introduced to other continents can become weeds or pests in their new environments. Ecology of hound's tongue (*Cynoglossum officinale*) has been studied. In Europe it is a species of natural environments such as sand dunes, while in North America it reaches high densities in rangelands that serve as cattle grazing areas. The plant is not edible, even toxic, so its presence reduces the amount of available food. A root-boring weevil (*Mogulones cruciger*) was introduced from Europe to western Canada and this introduction appears to be a success. It is capable of eradicating hound's tongue populations completely. This is surprising because the plant and the weevil coexist in Europe. Together with a researcher in weed biocontrol at the Agriculture and Agri-Food Canada research station in

Lethbridge (Alberta, Canada) why the effect of the weevil is so different between plants on the two continents has been investigated, with a focus on the question whether the introduced North-American plants have lost some sort of resistance to the weevil and can no longer adapt to its presence.

Representative References

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Funding

- UCL
- FSR
- FNRS

Partnership

- ▶ ROSE DECLERCK-FLOATE, Weed Biocontrol, Agriculture & Agri-Food Canada, Research Centre Lethbridge, Alberta, Canada
- ▶ CLAIRE PÉRILLEUX, Laboratoire de Physiologie végétale, Département des Sciences de la Vie,
- ▶ Université de Liège

Specific Tools & Main Equipment

Shared laboratory for genetic analyses (AFLP, microsatellites)

KEY WORDS

Natural hybridization
Genetic diversity
Introgression
AFLP
SSR
Pollination
Timing of flowering
Qtl mapping
Herbivory
Weed biocontrol
Threshold size for flowering

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Characterization of geomaterials - ore deposits in relation with the weathering of rocks

SENIOR SCIENTISTS:

► Johan YANS

Research Field and Subjects

Mining the raw material and ore deposits with respect to the environment are one of the next challenges. The researchers study, prospect and characterize (quality, quantity, environmental procedures) geomaterials and ore deposits in relation with the weathering of rocks. Such materials include kaolin deposits of Western Europe, nickel-cobalt ore deposits of New-Caledonia, copper-cobalt ore deposits of DR Congo, iron-manganese ore deposits of Tunisia, clays of Belgium. A special attention is given to the dating of the rocks. 3D-Modeling of ore deposits are done and environmental effects of mines and quarries are estimated.

Representative References

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- J. YANS and C. DUPUIS, *Timing of saprolitisation in the Haute-Lesse area (Belgium)*. Geophysical Research Abstract 7, 07064, **2005**.
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- S. DECREE, G. RUFFET, T. DE PUTTER, JM BAELE, P. RECOURT and J. YANS, *Complex Mn oxides in the Tamra iron mine: Ar-Ar geochronology and efficient traps for metal pollutants in a Fe-Pb-Zn mine environment*. Journal of African Earth Sciences, in press, **2009**.

Funding

- Minister of Foreign Affairs of Belgium, Walloon Region, WBI (Wallonie-Bruxelles International), CBR-Heidelbergement (private company),
- DIMENC (Direction de l'Industrie, des Mines et de l'Environnement de Nouvelle-Calédonie),
- BRGM-France (Bureau de Recherche en Géologie Minière),
- Valbois RN, SAUCCEL (Private company), Sables de Mettet (private company), SVK (private company).

Partnership

- ▶ WBI (Wallonie-Bruxelles International), University of Bizerte, ONM (Office National des Mines), University of Sfax, CERTE (Centre de Recherche et Technique de l'Eau): Valorisation of geomaterials of Nefza-Sejnane (Tunisia).
- ▶ Minister of Foreign Affairs of Belgium, Royal Museum of Central Africa, University of Lubumbashi: characterization of weathering Cu-Co ore deposits of RDC.
- ▶ Walloon Region, BRGM (Bureau de Recherches en Géologie Minière), University of Rennes, University of Strasbourg, University of Paris-Orsay, University of Brussels: characterization of weathered rocks of Wallonia.
- ▶ CBR-Heidelbergcement (private company): modelling of ore deposits for white cement industry.
- ▶ DIMENC (Direction de l'Industrie, des Mines et de l'Environnement de Nouvelle-Calédonie): Ni-Co weathered ore deposits of New-Caledonia.
- ▶ Valbois RN: Valorisation of kaolin deposits in the Ardenne area of Belgium.
- ▶ CSTC (Centre Scientifique et Technique de la Construction), SA Ecoterres, SAUCEL (Private company), Sables de Mettet (private company), SVK (private company): prospection of materials for industries in Belgium.

Main Equipment

Centrifugal, Grinder for rocks, Preparation of samples for clay determination (natural, ethylene-glycol saturated, heated), X-Ray Diffraction (including clay fraction), Optical Microscopy (including Reflection Microscope), Scanned Electron Microscopy, Transmission Electron Microscopy, GIS.

Products and Services

- ▶ Mineralogy, petrology, geochemistry of geomaterials and ores.
- ▶ Preparation of samples for dating of weathering products.
- ▶ 3D-modelling of deposits.

KEY WORDS

Weathering
Ore deposits
Geomaterials
Kaolin
Clays
Environment
Quarries
Pollution

SENIOR SCIENTIST

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Physical climatology

SENIOR SCIENTISTS:

- ▶ Thierry FICHEFET (Head)
- ▶ Michel CRUCIFIX
- ▶ Hugues GOOSSE
- ▶ Jean-Pascal van YPERSELE
- ▶ André BERGER (emeritus)
- ▶ Guy SCHAYES (emeritus)

Research Field and Subjects

Physical climatology includes the systematic study of the physical and dynamical properties of the Earth's climate system and its components across a range of time scales. With over 30 years of experience, UCL is recognized as one of the European centres of excellence in this area. Results of the research programmes undertaken at the UCL are regularly included in national and international assessment reports used by decision-makers in charge of the transition towards a sustainable development.

Main research topics

Study of climate variability and changes on various time and spatial scales, taking into account the different components of the Earth's climate system:

- Modelling palaeoclimates (with a focus on the Pleistocene and the last millennium);
- Past climate reconstructions combining models and proxy data;
- Modelling present-day and future climates;
- Large-scale sea-ice and ocean modelling;
- Study of regional and global atmospheric processes;
- Development of modelling tools, including data assimilation techniques.

Current representative projects

Global change

- Assessment of modelling uncertainties in long-term climate and sea level change projections (ASTER).
- Network for ice sheet and climate evolution (NICE).
- Comprehensive modelling of the Earth system for better climate prediction and projection (COMBINE).
- Palaeoclimates and climate of the last millennium
- Integrating theory and observations of the Pleistocene (ITOP).
- Earth system modelling of interglacials (EMIS).
- Learning from the past climate (Past4future).
- Decadal to centennial climate variability: a link between climate changes over the last millennium and recent changes.
- Climate impacts
- Article 2 of the Climate Convention and key vulnerabilities.
- Modelling the impact of aircraft emissions (ABCI).
- Impact of climate change on the hydrological cycle (SUDEM).

Representative References

- ▶ H. GOOSSE, H. RENSSSEN, A. TIMMERMANN AND R.S BRADLEY. *Internal and forced climate variability during the last millennium: a model-data comparison using ensemble simulations*. Quaternary Science Reviews 24, 1345-1360, **2005**.
- ▶ O. ARZEL, T. FICHEFET AND H. GOOSSE. *Sea ice evolution over the 20th and 21st centuries as simulated by current AOGCMs*. Ocean Modelling 12, 401-415, **2006**.
- ▶ E. DRIESSCHAERT, T. FICHEFET, H. GOOSSE, P. HUYBRECHTS, I. JANSSENS, A. MOUCHET, G. MUNHOVEN, V. BROVKIN AND S.L WEBER. *Modeling the influence of Greenland ice sheet melting on the Atlantic meridional overturning circulation*. Geophysical Research Letters, 34, L10707, doi: 10.1029/2007GL029516, **2007**.
- ▶ Q. YIN, A. BERGER, E. DRIESSCHAERT, H. GOOSSE, M.F LOUÏRE AND M. CRUCIFIX. *The Eurasian ice sheet reinforces the East Asian summer monsoon during the interglacial 500,000 years ago*. Climate of the Past, 4(2), 79-90, **2008**.
- ▶ M. CRUCIFIX AND J. ROUGIER. *On the use of simple dynamical systems for climate predictions: a bayesian prediction of the next glacial inception*. European Physics Journal - Special Topics, 174, 11-31, **2009**.
- ▶ H. GOOSSE, W. LEFEBVRE, A. DE MONTETY, E. CRESPIN AND A. ORSI. *Consistent past half-century trends in the atmosphere, the sea ice and the ocean at high southern latitudes*. Climate Dynamics, doi: 10.1007/s00382-008-0500-9, **2009**.
- ▶ M. VANCOPPENOLLE, T. FICHEFET, H. GOOSSE, S. BOUILLON, G. MADEC AND M.A MORALES MAQUEDA. *Simulating the mass balance and salinity of Arctic and Antarctic sea ice : I. Model description and validation*. Ocean Modelling, 27, 33-53, **2009**.
- ▶ J.B SMITH, H.S SCHNEIDER, M. OPPENHEIMER, G.W YOHE, W. HARE, M.D MASTRANDREA, A. PATWARDHAN, I. BURTON, J. CORFEE-MORLOT, CH.H.D. MAGADZA, H.M FÜSSEL, A.B PITTOCK, A. RAHMAN, A. SUAREZ AND J.P VAN YPERSELE. *Dangerous climate change:an update of the IPCC reasons for concern*. PNAS (Proceedings of the National Academy of Sciences of the United States of America), **2009**.

Main awards

- ▶ A. BERGER – Doctor A. De Leeuw-Damry-Bourlart Quinquennial Prize of the Belgian National Fund for Scientific Research, 1995.
- ▶ A. BERGER – European Latsis Prize 2001 of the European Science Foundation.
- ▶ J.P VAN YPERSELE – Energy and Environment Award (special award of the International Polar Foundation, 2006).
- ▶ The Nobel Peace Prize was awarded in 2007 to the Intergovernmental Panel on Climate Change (IPCC), of which T. FICHEFET and J.P VAN YPERSELE were Lead Authors. J.P VAN YPERSELE IS NOW Vice-Chairman of IPCC.
- ▶ T. FICHEFET – Adolphe Wetrems Prize (Mathematical and Physical Sciences) of the “Classe des Sciences de l’Académie Royale des Sciences, des Lettres et des Beaux-arts de Belgique”, 2005.
- ▶ T. FICHEFET – Gérard Mégie Prize 2008 of the “Académie des Sciences de l’Institut de France”.

Funding

- ▶ European Research Council (1 Senior Grant obtained in 2008, 1 Junior Grant obtained in 2009).
- ▶ European Commission (FP7).
- ▶ Belgian Science Policy Office.
- ▶ Belgian National Fund for Scientific Research.
- ▶ French Community of Belgium.
- ▶ Université catholique de Louvain.

Partnership

- ▶ Université libre de Bruxelles.
- ▶ Université de Liège.
- ▶ Vrije Universiteit Brussel.
- ▶ Institut Pierre Simon Laplace, Paris.
- ▶ Laboratoire de Glaciologie et de Géophysique de l’Environnement, Grenoble.
- ▶ University of Bristol, Bristol.
- ▶ U.K. Meteorological Office, Exeter.
- ▶ Vrije Universiteit Amsterdam, Amsterdam.
- ▶ Max Planck Institute for Meteorology, Hamburg.
- ▶ Koninklijk Nederlands Meteorologisch Instituut, De Bilt.
- ▶ Climate Limited-area Modelling Community.
- ▶ Swedish Meteorological and Hydrological Institute, Norrköping, Sweden.
- ▶ University of Washington, Seattle.
- ▶ Belgian Federal Council for Sustainable Development.
- ▶ Intergovernmental Panel on Climate Change.

Specific tools & Main Equipment

- ▶ Access to supercomputing facilities

Products and Services

- ▶ Calculation of changes in insolation related to periodic variations in the Earth’s orbital elements.
- ▶ Study of the long-term evolution of climate using dynamical systems and Earth system models of intermediate complexity.
- ▶ Reconstruction of past climates using data assimilation methods in models.
- ▶ Study of meteorological and climatic processes at the regional and global scales with three-dimensional climate models.
- ▶ Analysis of sea-ice dynamics (past, modern and future climates), monsoon and related tropical processes (past and modern climates), and the dynamics of the coupled ocean-atmosphere-biosphere-cryosphere system, with focus on polar regions.
- ▶ Incorporate climate knowledge into socio-economical models
- ▶ Study of the role of demographic rise into CO2 emissions.
- ▶ Communication to the general public and policy-makers.

KEY WORDS

Climate modelling
Climate change
Paleoclimates
Greenhouse effect
Climate variability
Polar regions
Atmosphere
Ocean
Sea ice
Climate impacts

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Climate change economics

SENIOR SCIENTIST:

► Bertrand HAMAIDE

Research Field and Subjects

Among the large research scope of climate change economics, this particular research field aims at studying various policy options within the theoretical framework of cooperative game theory, or cost-benefit analysis, or input-output analysis. The purpose is to estimate the cost of reaching a particular policy option, or the cost of respecting the Kyoto Protocol, or the environmental and economic impact of an optimal policy.

A refinement under progress is to include the impact of flexibility mechanisms in the analysis.

SENIOR SCIENTIST

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Representative References

- B. HAMAIDE AND J. J. BOLAND. *Benefits, Costs and Cooperation in Greenhouse Gas Abatement*. Climatic Change, Vol 47, 239-258, **2000**.
- B. HAMAIDE. *Economic and Political Cooperation in Various Climate Policy Scenarios*. Climate Policy, Vol. 3, nr 2, 71-78, **2003**.
- B. HAMAIDE. *Analyse économique de l'effet de serre et pertinence du Protocole de Kyoto*. Economie Appliquée, Vol.52, nr. 2, 147-169, **2004**.
- B. HAMAIDE AND J. J. BOLAND. *Cost-Benefit Analysis Is Useful In Evaluating Climate Change Policies*. World Resource Review, Vol.18, nr.2, p.427-438, **2006**.
- BENOIT LIXON, PAUL THOMASSIN AND BERTRAND HAMAIDE. "Industrial Output Restriction and the Kyoto Protocol: An Input-Output Approach with Application to Canada", Ecological Economics, vol.68, 249-258, **2008**.

Novel Ecological processes

SENIOR SCIENTIST:

► Istvan MARKÓ

Research Field and Subjects

The research focuses on the development of novel ecologically respectful transformations, the total synthesis of complex natural products, the development of new and efficient methodologies, asymmetric catalysis with and without metals, organometallic chemistry, electroorganic synthesis and botanocchemistry. These topics closely interact; for instance, various total synthesis very much rely upon the development of new and efficient synthetic methodologies or on application (in key step) of either a new organometallic mediated reaction or an efficient catalytic process.

The synthesis of a variety of biologically active molecules, with important pharmacological or agrichemical properties, are being currently studied. The research mainly focuses on protein phosphatase inhibitors (Okadaic Acid and Calyculins), antitumor compounds (Spongistatins, Manzamin A), antifungals (Ambruticin, Milbemycin β 3, Jerangolid and Amphidinol), non-lactam antibiotics (Pseudomonic Acid and Clerocidin), hormones (Steroids), alkaloids (Reserpine, Strychnine, Terpenes), marine toxins (Polycavernosides A), terpenes (Hinesol) and finally, tumor promoters such as Ingenol.

Representative References

- G. BERTHON-GELLOZ, M. A. SIEGLER, A. L. SPEK, B. TINANT, J. N. H. REEK, I. E. MARKÓ, *IPr* an easily accessible highly hindered N-heterocyclic carbene*, Dalton Transactions, 39(6), 1444-1446, **2010**.
- I. E. MARKÓ, J. POSPISIL, *Julia, Julia-Kocienski, and related sulfur-based alkenations*, Science of Synthesis, 47a, 105-160, **2010**.
- K. LAM, I. E. MARKÓ, *Toluates: unexpectedly versatile reagents*, Tetrahedron, 65, 10930-10940, **2009**.
- J. COSSY, T. TSUCHIYA, S. REYMOND, T. KREUZER, F. COLOBERT, I. E. MARKÓ, *Convergent synthesis of the C18-C30 fragment of amphidinol 3*, Synlett, 2706-2710, **2009**.
- C. SCHULTZ-FADEMRECHT, O. KINZEL, I. E. MARKÓ, T. POSPISIL, S. PESCI, M. ROWLEY, P. JONES, *A general approach to homochiral α -amino substituted bromo-heteroaromatics suitable for two-dimensional rapid analogue synthesis*, Tetrahedron, 65, 9487-9493, **2009**.

► K. LAM, I.E. MARKÓ, *Chemoselective Chemical and Electrochemical Deprotections of Toluates*, Synfacts, 9, 1023-1023, **2009**.

► K. LAM and I.E. MARKÓ, *Chemoselective Chemical and Electrochemical Deprotections of Aromatic Esters*, Organic letters **2009** 11, 2752-2755.

Patents (selected)

"Use of an aromatic carboxylic acid in an asymmetric catalysis reaction, particularly Aldol condensation, in combination with pyrrolidine-containing chiral derivatives of diamines, amino alcohols, carbonyls, and monosulfonyl compounds." Markó, Istvan; De Paolis, Michael; Mignani, Gerard, Fr. Demande 2006 54 pp. CODEN: FRXXBL FR 2877335 A1 20060505 CAN 144:450506 AN 2006:409416 CAPLUS

"An efficient and stereoselective process for large scale synthesis of (R)-3-(2,3-dihydro-benzofuran-5-yl)-1,2,3,4-tetrahydropyrrolo[3,4-b]quinolin-9-one." Li, Xun; Lemaire, Sebastien; Markó, Istvan; Willemsens, Albert, PCT Int. Appl. 2006 57pp. CODEN: PIXXD2 WO 2006093719 A1 20060908 CAN 145:314972 AN 2006:916385 CAPLUS

"Process for carbon-carbon bond formation by palladium-catalyzed coupling of arenediazo ethers, prepared without isolation of the diazonium salt intermediate, with unsaturated compounds." Markó, Istvan; Dejeaifve, Alain; Saint Jalmes, Laurent, Fr. Demande 2005, 34 pp. CODEN: FRXXBL FR 2868417 A1 20051007 CAN 143:367069 AN 2005:1073666 CAPLUS. (Rhodia Chimie, Fr.)

"2,6-Bis(arylhydroxymethyl)pyridines and analogous compounds useful as ligands for organometallic oxidation and epoxidation catalysts." Markó, Istvan; Bernini, Maristella; Phillipson, Neil; Nedden, Hans Gunter; Tinant, Bernard., Fr. Demande 2003, 18 pp. CODEN: FRXXBL FR 2834287 A1 20030704 Patent written in French. Application: FR 2002-436 20020115. Priority: FR 2001-8692 20010629. CAN 139:69166 AN 2003:516852 CAPLUS (Copyright (C) 2005 ACS on SciFinder (R)) (Rhodia Chimie, Fr.)

“Single_step method for preparing Group VIII metallic carbene-based catalysts for hydrosilylation of unsaturated compounds and resulting catalysts” Buisine, O., Markó, I.E., Sterin, S, PCT Int. Appl., 2002, 50 pp .AN, CAN 138 :24835 CODEN : PIXXD2 WO 0298888 A1 20021212

Awards (selected)

2005 Merck Lectureship Award
2005 Upper Rhine Lectureship Award
2005 Merck Academic Development Program Award
2005 Zeneca Foreign Lectureship Award
2006 Merck Academic Development Program Award
2006 Prix Tractebel Environnement
2007 Merck Academic Development Program Award
2007 Roche Chemistry Lectureship
2008 Merck Academic Development Program Award
2008 Boehringer Ingelheim Distinguished Lectureship

Funding

- ▶ FRIA
- ▶ FNRS
- ▶ Private Industries

Partnership (non-exhaustive)

Norway, University of Tromsø
Hungary, Chemical Research Center, Hungarian Academy of Sciences
France, Université de Rouen
Finland, Helsinki University of Technology
Belgium, FUNDP, VUB, Ghent
Prof. Jean-Paul DECLERCQ, UCL
Prof. Stanley LUTTS, UCL
Prof. Marie-Laure FAUCONNIER,
Gembloux - ULG

Main Equipment & Specific Tools

All required organic chemistry equipment.
The necessary electrochemistry equipment.
Scale-up equipment.
Spectroscopic equipment, including NMR, MS...

Products and Services

▶ Spectroscopic identification of new compounds, isolation, separation and quantification of known and unknown chemicals, total synthesis of lead products, new chemical entities, novel scaffolds, development of new synthetic routes, generation of various synthetic routes, process optimisation, use of enzymes and whole cells or plants to perform organic transformations, ...

KEY WORDS

Chemistry
Organocatalysis
Catalysis
Organic electrochemistry
Botanochemistry
Synthesis
Plants
Vegetables
Enzymes
Biochemistry
Proteins
CO₂ recycling

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Air Pollution Laws and Policies

SENIOR SCIENTISTS:

- ▶ François OST
- ▶ Delphine MISONNE

Research Field and Subjects

The research is about legal protection of air quality at the international, European or Belgian level, with a focus on the relevancy of specific legal tools and instruments (emission standards, immission standards, product norms, taxes, best available technologies, flexible mechanisms, etc.). Links are made to mobility, planning and energy laws and policies.

Representative References

- ▶ D. MISONNE, *La fiscalité des déplacements des particuliers : vers une mobilité durable ?* Revue, Aménagement-Environnement, **2002**.
- ▶ D. MISONNE, *Pollution atmosphérique, circulation routière et règles de répartition des compétences entre l'Etat fédéral et les régions – à propos de l'article 5 § 2 de la loi sur les normes de produits*. N° spécial consacré à la mobilité. Aménagement-Environnement, **2002/3**.
- ▶ D. MISONNE & M. HUBERT, *Les communes bruxelloises et la mobilité : entre autonomie et convergence* in *Les dix-neuf communes bruxelloises et le modèle bruxellois*. Larcier, **3**, **2003**.
- ▶ D. MISONNE, *La directive 2003/87/CE relative au marché d'émission et sa transposition en droit belge - Analyse préliminaire sous le prisme de la répartition des compétences* in *L'échange des droits de pollution comme instrument de gestion du climat*. La Chartre, **2005**.

Funding

Federal Science Policy
Federal and regional public authorities

Partnership

- ▶ IRIB
- ▶ IRIS
- ▶ ELNI
- ▶ SERES

Products and Services

- ▶ Legal advice on Environmental Law issues
- ▶ Drawing up legislation
- ▶ Master's degree on Environmental Law and Country Planning Law
- ▶ Seminars and conferences

KEY WORDS

Environment
Law
Policy
European law
Air
Climate change
Mobility
Flexible mechanisms
Trading
Planning

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Transfer of green technologies and climate change

SENIOR SCIENTISTS:

- ▶ Alain STROWEL
- ▶ Estelle DERCLAYE

Research Field and Subjects

Intellectual property rights and patents in particular are considered either as the indispensable incentive for companies to invest in green technologies or, on the contrary, as a brake for the wide dissemination of such technologies. The first view is widely shared in developed countries, in particular with business circles; on the other hand developing and emerging countries (eg China and India) have voiced concerns about the blocking effects of patents for the international transfer of technologies. More research is needed to identify under which conditions patents can promote or block the transfer of green technologies. Since the 70's several international bodies (e.g. at the UN level) have focused on the development of instruments to increase the pace of technology transfers in favour of less-developed countries (model provisions for technology transfer contracts, etc.). Those attempts have usually not led to the right level of adequate technology transfer. Many reasons can explain this (for example. the role of "tacit knowledge" in fostering North-South technology transfers).

Today the world probably faces the most urgent technology transfer task in its history in the field of green technologies (for ex. carbon capture and storage technologies). New interdisciplinary studies (combining legal, economic and technical dimensions) are needed to better identify the obstacles for the adoption of green technologies and to propose remedies (e.g. open licensing as a private governance tool or compulsory licensing as a state-based tool).

Representative References

- ▶ E. DERCLAYE, *Patent Law's Role in the Protection of the Environment. Re-assessing Patent Law and its Justification in the 21st Century*, IIC, p. 249-273, **2009/2**.
- ▶ E. DERCLAYE, *Should Patent Law Help to Cool the Planet ?* EIPR, 168-184, 227-235, **2009**.

Partnership

- ▶ CEDRE (FUSL)
- ▶ IEJE (Ulg)

KEY WORDS

Patents
Intellectual property
Law
Technology transfer
North-south relations
Climate change
Green technologies

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The role of soils in the Carbon cycle

SENIOR SCIENTISTS:

- ▶ Bas VAN WESEMAEL
- ▶ Kristof VAN OOST

Research Field and Subjects

Soils are one of the largest pools in the global carbon cycle. Still the soil-atmosphere exchanges of CO₂ are poorly quantified as a result of their large spatial variability and the slow reaction of soil organic carbon (SOC) to change in land use and management. Monitoring changes in SOC content allows to quantify soil-atmosphere CO₂ fluxes. Erosion and sedimentation of soil and associated organic matter within the landscape are quantified as sources or sinks of CO₂. Changes in SOC over time are estimated in order to control the spatial variability of SOC within landscapes, using fractionation techniques, imaging spectroscopy techniques for rapid assessment of SOC contents, and new integrative modelling approaches.

Representative References

- ▶ K. VAN OOST, T.A. QUINE et al., *The impact of agricultural soil erosion on the global carbon cycle*. *Science*, 318(5850): 626-629, **2007**.
- ▶ A. STEVENS, B. VAN WESEMAEL, H. BARTHOLOMEUS, D. ROSILLON, B. TYCHON and E. BEN-DOR, *Laboratory, field and airborne spectroscopy for monitoring organic carbon content in agricultural soils*. *Geoderma* 144, 395-404, **2008**.
- ▶ J. MEERSMANS, B. VAN WESEMAEL, F. DE RIDDER, M. FALLAS DOTTI, S. DE BAETS and M. VAN MOLLE, *Changes in organic carbon distribution with depth in agricultural soils in northern Belgium, 1960-1990*. *Global Change Biology* 15, 2739-2750, **2009**.
- ▶ E. GOIDTS, B. VAN WESEMAEL and K. VAN OOST, *Driving forces of soil organic carbon evolution at a regional scale using data from a stratified soil monitoring*. *Global Change Biology* 15, 2981-3000, **2009**.

Funding

- ▶ EU
- ▶ Communauté française de Belgique

Partnership

- ▶ BRGM, Orléans France

Specific Tools & Main Equipment

- ▶ CN analyzer
- ▶ Percussion drilling equipment

Products and Services

- ▶ SOC inventories

KEY WORDS

Soil-atmosphere
CO₂
Organic carbon
Spatial modelling
Imaging spectroscopy

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Global changes on Earth during the geological times

SENIOR SCIENTIST:

▶ Johan YANS

Research Field and Subjects

The Earth has experienced many global changes over the last 540 Millions years. These climatic, geochemical and biological perturbations have been recorded in the rocks and provide good analogies with the current global changes. The FUNDP Namur Department of Geology focuses on the major perturbations of the following geological periods: (1) abrupt warming of Palaeocene-Eocene period and correlative development of modern mammals, and (2) Warm Cretaceous period.

Representative References

- ▶ J. YANS, J. DEJAX, D. PONS, C. DUPUIS and P. TAQUET, *Paleontologic and geodynamic implications of the palynological dating of the Bernissart wealden facies sediments (Mons Basin, Belgium)*. *Paleovol* 4, 135-150, **2005**.
- ▶ J. VANMEIRHAEGHE, J. YANS, A. PRÉAT, N. GRASSINEAU and J. VERNIERS, *New evidence for the Hirnantian (Upper Ordovician) in Belgium? An integrated isotopic, biostratigraphical and sedimentological approach*. *Notebooks on Geology e-Journal*. *Memoir* 2005/02, 63-68, **2005**.
- ▶ J. YANS, S. STRAIT, T. SMITH, C. DUPUIS, E. STEURBAUT and P. GINGERICH, *High-resolution carbon isotope stratigraphy and mammalian faunal change at the Paleocene-Eocene boundary in the Southern Bighorn Basin, Wyoming*. *American Journal of Sciences* 306, 712-735, **2006**.
- ▶ Y. QUINIF, H. MEON and J. YANS, *Nature and dating of karstic Cretaceous filling in the Hainaut Province (Belgium)*. *Karstic, geodynamic and paleogeographic implications*. *Geodynamica Acta* 19/2, 73-85, **2006**.
- ▶ J. YANS, R.M. CORFIELD, G. RACKI and A. PREAT, *Evidence for a major perturbation of the carbon cycle in the Middle Frasnian punctata conodont Zone*. *Geological Magazine* 144/2, 263-270, **2007**.
- ▶ J. DEJAX, D. PONS and J. YANS, *Palynology of the dinosaur-bearing Wealden facies sediments in the natural pit of Bernissart (Belgium)*. *Review of Palaeobotany and Palynology* 144, 25-38, **2007**.

▶ J. SCHNYDER, J. DEJAX, E. KEPPENS, T. NGUYEN TU, P. SPAGNA, S. BOULLIA, B. GALBRUN, A. RIBOULLEAU, JP. TSHIBANGU and J. YANS, *An Early Cretaceous lacustrine record: Organic matter and organic carbon isotopes at Bernissart (Mons Basin, Belgium)*. *Palaeogeogr., Palaeoclimatol., Palaeoecol.* 281, 79-91, **2009**.

Awards

Laureate 2006 of the Belgium Academy of Sciences (section Geology and Earth Sciences).

Funding

- ▶ FNRS-FRS,
- ▶ BRGM (Bureau de Recherche en Géologie Minière-France).

Partnership

- ▶ University of Parma,
- ▶ Royal Holloway of London,
- ▶ Museum of Natural History of Paris,
- ▶ University of Jussieu,
- ▶ BRGM (Bureau de Recherche en Géologie Minière-France),
- ▶ University of Lyon,
- ▶ University of Bilbao,
- ▶ University of Michigan,
- ▶ University of Plymouth,
- ▶ University of Silesia,
- ▶ University of Brussels,
- ▶ University of Ghent,
- ▶ University of Liège.
- ▶ Royal Institute of Natural Sciences of Belgium.

Specific Tools & Main Equipment

Centrifugal, Grinder for rocks,
Preparation of samples for clay determination (natural, ethylene-glycol saturated, heated),
X-Ray Diffraction (including clay fraction), Optical Microscopy (including Reflection Microscope),
Scanned Electron Microscopy,
Transmission Electron Microscopy.

Products and Services

- ▶ Decarbonation of sediments
- ▶ Petrology, mineralogy and geochemistry of sediments in relation with global changes on Earth
- ▶ Preparation of samples for carbon isotopes analyses
- ▶ Clay fraction determination
- ▶ CaCO₃ content of rocks,

KEY WORDS

Global changes
Climate
Earth
Geological perturbations
Analogue
Carbon isotopes
Palaeocene-Eocene
Cretaceous

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Coping with floods and inundations

SENIOR SCIENTISTS:

- ▶ Yves ZECH
- ▶ Sandra SOARES-FRAZÃO

Research Field and Subjects

One of the probable consequences of global climate changes is the worsening of hydrological extremes, especially flood events. Most of the protecting structures (dams and dikes) will undergo threats probably greater than expected at the time of their design. Failure of such structures and consequences of these failures have to be considered in a perspective of sustainable development. This is achieved through:

- ▶ Physical and numerical modelling of flood waves due to dam- or dyke-break and consecutive inundations, including consequences on sediment transport and morphological evolutions.
- ▶ Study and design of preventing and protecting works against inundation: storage reservoir, flood plains, etc.

Representative References

- ▶ C. DAL CIN, L. MOENS, PH. DIERICKX, G. BASTIN, Y. ZECH, *An integrated approach for real-time flood-map forecasting on the Belgian Meuse River*, Natural Hazards, Volume 36, Issue 1-2, 2005, pp. 237-256 (Impact factor in 2004: 0.709), **2005**.
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- ▶ L. GOUTIÈRE, S. SOARES-FRAZÃO, C. SAVARY, T. LARAICHI, Y. ZECH, *One-Dimensional Model for Transient Flows Involving Bed-Load Sediment Transport and Changes in Flow Regimes*, Journal of Hydraulic Engineering, American Society of Civil Engineers (ASCE), vol. 134 (6), pp. 726-735, **2008**.
- ▶ Y. ZECH, S. SOARES-FRAZÃO, B. SPINOWINE, N. LE GRELLE, *Dam-break induced sediment movement: Experimental approaches and numerical modelling*, Journal of Hydraulic Research, Vol. 46 (2), pp. 176–190, **2008**.
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Funding

- ▶ US National Science Foundation
- ▶ European Union

Partnerships

- ▶ National Taiwan University, Prof. D.L. Young, Prof H. Capart
- ▶ Ecole Polytechnique Fédérale de Lausanne (EPFL), Prof A. Schleiss
- ▶ Eidgenössische Technische Hochschule Zürich (Ecole Polytechnique Fédérale de Zurich ETHZ), Prof W. Hager
- ▶ Université Montpellier 2, Prof. V. Guinot
- ▶ Università degli Studi di Pavia, Prof. L. Natale, Prof. F. Savi
- ▶ CEMAGREF Lyon, Prof. A. Paquier
- ▶ Università degli Studi di Napoli Federico II, Prof. M. Greco, Prof. D. Pianese
- ▶ University of Mississippi, Oxford, Prof. M. Altinakar and W. Wu
- ▶ Rijksuniversiteit Gent, Prof. P. Troch

Main Equipment & Specific Tools

- ▶ Test flume 36 m length, 3.60 m width and 0.50 m depth; discharge up to 250 l/s
- ▶ Sedimentological test flume, 7.5 m length, 0.50 m width and 0.45 m depth; discharge up to 40 l/s; slope from 0 to 5 %
- ▶ Compound channel test flume, 10 m length, 1.20 m width and 0.30 m depth; discharge up to 40 l/s; slope from 0 to 3 %
- ▶ Test flume for dam-break over mobile sediments, 6 m length with jack-controlled downwards moving gate, 0.25 m width adjustable up to 0.50 m over half of the length

Products and Services

- ▶ Real-time prediction of water level on Rivers
- ▶ Preliminary design of navigation lock, filling/emptying systems
- ▶ Solid transport in canalized River
- ▶ Audit of River models
- ▶ Flood water profile in rivers

KEY WORDS

Fluvial hydraulics
Floods
Dykes
Dams
Breaching
Dyke-break
Inundations
Rivers
Flood plains
Compound channels

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Analysis and modelling of mobility

SENIOR SCIENTISTS:

- ▶ Eric CORNELIS
- ▶ Philippe TOINT

Research Field and Subjects

The researches explicitly focus on the analysis of the daily travel and mobility of individuals, using aggregate and disaggregate models. The main active developments are focusing on disaggregate demand models including a synthetic population description for Belgium and a comprehensive activity-based demand model. A majority of the current research projects aim at developing these into a coherent framework. The usefulness of models being limited by the availability of input data, the research interests also cover mobility-oriented data collection. (e.g. coordination of the first Belgian national daily mobility survey (MOBEL), as well as the new one (BELDAM)). The research group is also involved in several other surveys. Finally, because discrete choice models occur frequently in disaggregate transportation models, the group also develops research on this methodology as such.

The research goal is clearly a better understanding of the mobility behaviours, which is a crucial step to founding policies aiming at sustainable mobility.

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- ▶ E. CORNELIS, C. RIZET ED. *Abatement measures for the freight transport sector*, Presses Universitaires de Namur, 174p., **2008**.
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- ▶ J. POLAK, E. CORNELIS. *Best practices in Data Fusion : Synthesis of a Workshop in Transport Survey Methods Keeping Up with a Changing World*. P. BONNEL ET ALII ED. 613-619, Emerald, **2009**.

Funding

- ▶ BELSPO
- ▶ ADEME
- ▶ ESF
- ▶ ARC
- ▶ ANR

Partnership

- ▶ COST
- ▶ EUROCITIES-DATTA
- ▶ INRETS
Univ. Westminster (UK)
- ▶ BELSPO
- ▶ DIDAM
- ▶ CEPS-INSTEAD (Lux.)

Products and Services

- ▶ Databases on Belgian mobility (especially from the MOBEL national survey) available for remote statistical queries on www.mobel.be
- ▶ Skills in designing, conducting and analysing mobility surveys
- ▶ Skills in modelling mobility
- ▶ Skills in analysing pollutant emissions and energy consumption due to mobility
- ▶ Skills in modelling and analysing the impacts of policy measures on mobility. These policies could also be related to land use and other topics which are linked with mobility behaviours

KEY WORDS

Mobility
Transport
Survey
Behaviour
Activity-based models
Discrete choice models
Pollutant emissions
Energy consumption
Mobility demand

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Land use planning: rural and urban areas

SENIOR SCIENTISTS:

- ▶ Pierre DEFOURNY
- ▶ Yves HANIN
- ▶ Dominique HIBO

Research Field and Subjects

- ▶ Characterisation and spatio-temporal modelling of land dynamics.
- ▶ Critical analysis of common practices in land management, peri-urban and rural development including in developing countries.
- ▶ Technological transfer and development of Geographical Information Systems for decision support tool adapted to impact assessment study, mobility, rural development, land use planning, and land management.
- ▶ Advanced methods for quality control, update and fusion of geographical dataset.
- ▶ Design and development of numerical methods for land simulation and decision support tool. Spatial modelling through Geographical Information Systems.
- ▶ Design and implementation of Geographical Information Systems in the field of land management and land use planning.
- ▶ Intensive training in Geographical Information Systems applied to land management and landscape ecology.
- ▶ Impact assessment study by an authorised center (CREAT), for the following categories:
 - Land use planning, urban planning, commercial and leisure activities;
 - Infrastructure projects for transportation networks and communication;
 - Mining and quarries.

Representative References

- ▶ O. DUBOIS and Y. HANIN, *L'occupation du sol en Wallonie*, Plaquelette n°5 de la CPDT, Ministère de la Région wallonne, Namur, p.112. **2005**.
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Funding

- ▶ European Union INCO program (EU-INCO)
- ▶ Belgian Sciences Policy Office (Belspo)
- ▶ Region Wallonne (RW)
- ▶ European Spatial Agency (ESA)

Partnership

- ▶ Collège Interdisciplinaire Territoires et Développement Durable
- ▶ Private consultant companies
- ▶ La Commission Universitaire pour le Développement (CUD)
- ▶ Conférence Permanente du Développement Territorial (CPDT)
- ▶ UN-FAO, CGIAR Center
- ▶ UCL- Geomatics. Earth and Life Institute ; Université catholique de Louvain
- ▶ Centre d'étude en aménagement du territoire (CREAT), Université catholique de Louvain

Main Equipment

- ▶ Professional softwares for GIS and remote sensing : ArcGIS, StarCarto, Mapinfo, Idrisi, Imagine, ENVI, e-Cognition Definiens as well as A0 digitising tables and Aplotter A0.
- ▶ Large range of Global Positioning Systems (GPS) receivers including Leica and Trimble base station.
- ▶ Multi-processor high speed computing servers offering large storage capacity and data processing
- ▶ Training classrooms facilities fully equipped

Products and Services

- ▶ Integrated GIS development for management, monitoring, distribution and updating of maps and spatial data.
- ▶ Intensive training program and continuing education program.
- ▶ Mapping of local and national levels (UNESCO, Belspo)
- ▶ GIS applications for environmental impact assessment studies.
- ▶ Scientific contribution to the management of flooded areas and rehabilitation of valleys.
- ▶ Impact study of railways and roads infrastructures project on rural areas.
- ▶ Spatial Integration of agri-environmental map features to support the Walloon administration for agriculture (PICEA project) in collaboration with RW-DGA.
- ▶ «Forest natural resources participatory management in the Philippines» (with ESSC).
- ▶ Europe land use mapping based on ENVISAT MERIS dataset (Projet GlobCorine de l'ESA).
- ▶ Global land use mapping based on ENVISAT MERIS dataset (GLOBCOVER project - ESA)
- ▶ Scientific contribution to the Programme wallon de Développement rural en Région wallonne (RW)

KEY WORDS

Land management
Mapping
Rural development
Landscape ecology
Impact assessment studies
Geomatics
Developing countries
Geographical Information System (GIS)
Remote sensing

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Land Use Change and its impacts on the environment

SENIOR SCIENTIST:

► Nicolas DENDONCKER

Research Field and Subjects

Present research focuses on modelling land use change and its impacts on the environment (e.g. on soil organic carbon sequestration, biodiversity and other ecosystem services) in the context of a number of EU and national research projects (see partnerships). A variety of spatial-statistical techniques as well as rule-based environmental models have been used. In collaboration with other researchers a model to downscale land use data and scenarios has been developed. In general, interest of the research lies in uncertainty and scale issues, for example uncertainties in model outputs that arise from scaling or using poor quality datasets.

The main focus of the research is on developing agent-based models (ABM) of land use and environmental change in the context of the EU-funded ECOCHANGE project and the Bel-spo-funded MULTIMODE project. In particular, the development, applications and consequences of agri-environmental measures are examined for a series of case studies in Belgium and throughout Europe. These models are combined with the development of scenarios to explore the response of individuals and society to different drivers of future environmental change. Stakeholders are involved from the beginning to the end of the project. An expertise in participatory modelling and GIS has been developed. The impacts of these landscape changes on ecosystem services are assessed and sustainable development pathways are proposed.

Representative References

- N. DENDONCKER, B. VAN WESEMAEL, M. ROUNSEVELL, C. ROELANDT AND S. LETTENS. *Belgium's CO₂ mitigation potential under improved cropland management. Agriculture, Ecosystems and Environment*. 103, 101-116, **2004**.
- M. ROUNSEVELL, I. REGINSTER, M. ARAUJO, T. CARTER, N. DENDONCKER, F. EWERT, J. HOUSE, S. KANKAANPAA, R. LEEMANS, M. METZGER, C. SCHMIT, P. SMITH, AND G. TUCK. *A coherent set of future land use change scenarios for Europe. Agriculture, Ecosystems and Environment*, 114 (1), 57-68, **2006**.
- N. DENDONCKER, P. BOGAERT, AND M. ROUNSEVELL. *A statistical method to downscale aggregated land use data and scenarios. Journal of Land Use Science* 1 (2), 63-82, **2006**.
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- N. DENDONCKER, C. SCHMIT, AND M. ROUNSEVELL, M. *Exploring spatial data uncertainties in land use change scenarios. International Journal of Geographical Information Science* 22 (9), 1013-1030, **2008**.
- G.F. FICETOLA, L. MAIORANO, A. FALCUCCI, N. DENDONCKER, L. BOITANI, E. PADOA-SCHIOPPA, C. MIAUD AND W. THULLER. *Knowing the past to predict the future : land use change and the distribution of invasive bullfrogs. Global Change Biology*, **2009** (In press, available online).

Funding

- ▶ European Commission
- ▶ Belspo

Partnership

- ▶ Participation in the EC-funded project ECOCHANGE: Biodiversity and Ecosystems Changes in Europe.
- ▶ Participation in the EC-funded project FRAGILE: FRagility FRagility of Arctic Goose habitat: Impacts of Land use, conservation, and Elevated temperature.
- ▶ Participation in the EC-funded project ALARM : Assessing LArge scale Risks for European biodiversity with tested Methods.
- ▶ Participation in ALTERNet (A long-term biodiversity, ecosystem and awareness research network)
- ▶ Participation in the Swedish research project mistra-SWECIA : Mistra SWEdish research programme on Climate, Impacts and Adaptation
- ▶ Participation in the Belgian research project MULTIMODE : A Multiscalar and Multiagent Modelling Framework for Assessing Sustainable Futures in a Globalised Environment
- ▶ Participation in the joint IGBP-IHDP Global Land Project

Products and Services

- ▶ Participatory Methods
- ▶ GIS
- ▶ Agent-based modelling
- ▶ Spatial statistics
- ▶ Spatial land use change data

KEY WORDS

Land use
Participatory Modelling
Geographical Information System (GIS)
Agent-based Modelling
Agri-environmental Measures
Ecosystem Services
Biodiversity
Sustainable agriculture
Prospective analysis

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Population and environment: health and migration concerns

SENIOR SCIENTIST:

▶ Sabine HENRY

Research Field and Subjects

The main issue is the consequences of climatic and soil conditions for the populations in the Southern countries in order to preserve local economies sustainability. In West Africa, the impacts of climate variations (e.g. rainfall, temperature, dust concentrations) on child health is highlighted by using socio-demographic, health and climate data at a fine spatial and temporal resolution. The impacts of extreme climatic events on the occurrence and the intensity of acute respiratory infections are highlighted by using spatial and temporal associations. Multilevel event-history methods are used to estimate the impact of various characteristics of the environment on child survival, controlling for relevant variables related to the child and his/her mother. A qualitative approach is used to understand the perceptions of population and their adaptation strategies to climate change.

The contribution of the migrants to the sustainable development of their country of origin is the object of a wide debate in the literature. In West-Africa, Ecuador and Philippines, the integration of socio-demographic with biophysical data allows better to understand the links between soil conservation and international or internal migrations. The social characteristics of the households, their access to the soil and the physical characteristics of their plots of land determine the characteristics of migration and the agricultural practices and land use of the "left-behind" populations. The combination of methods (qualitative and quantitative methods with a participatory approach) allows to identify the benefits of the migrations on soil conservation and more generally to contribute to a better general understanding of the role of the migrant as agent of development for its country of origin or at the destination.

Representative References

- ▶ S. HENRY, B. SCHOUAKER, C. BEAUCHEMIN. *The impact of environmental conditions on migration in Burkina Faso: an event-history analysis*. Population and Environment, n°25(5), 423-460, **2004**.
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- ▶ S. DOS SANTOS, S. HENRY. *Rainfall Variation as a Factor in Child Survival in Rural Burkina Faso The Benefit of an Event-History Analysis*. Population Space and Place, 14, 1-20. **2008**.
- ▶ A. DE SHERBININ, L. VANWEY, K. MCSWEENEY, R. AGGARWAL, A. BARBIERI, S. HENRY, L. HUNTER, W. TWINE, AND R. WALKER. *Rural Household Micro-Demographics, Livelihoods and the Environment*. Global Environmental Change, 18, 38-53, **2008**.
- ▶ F. DE LONGUEVILLE, S. HENRY, P. OZER. *Saharan dust outbreaks: What about air pollution and human health implications in the Sahel?* Epidemiology, 20 (5), 780. **2009**.
- ▶ S. HENRY, R. BILSBORROW. *How migrants choose their place of destination in Burkina Faso?* Population Studies (submitted).

Awards

Poster Award at the PAA Annual Meeting, 2008 for S. HENRY, S. DOS SANTOS "Rainfall Variations and Child Mortality in Sahelian Region: Results from a comparative analysis in Burkina Faso and Mali", New Orleans, 17-19 April 2008.

Funding

- ▶ CUD
- ▶ FUNDP

Partnership

- ▶ MRTC, Bamako
- ▶ Columbia University, USA
- ▶ IRD/LPED, Dakar
- ▶ UCL
- ▶ KUL
- ▶ University of Cuenca, Ecuador
- ▶ ESSC, Philippines
- ▶ Carolina Population Center, USA

Specific Tools & Main Equipment

- ▶ ArcGIS (GIS and remote sensing)
- ▶ Stata (statistical software)

Products and Services

- ▶ GIS mapping of population and health issues
- ▶ Integration of biophysical and human data
- ▶ Spatial statistics and modelling

KEY WORDS

Migration
Child mortality
Health, climate
Event-history
Soil
Land degradation
Drought
Dust
Protection of soils and desertification
Technical management of climate change impact
Migration and sustainability
Demographic dynamics

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Job and daily mobility in practices

SENIOR SCIENTIST:

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Research Field and Subjects

Job and daily mobility in practices. Sociological study of experiences in time, space and use of modes of transport. Users' views of the public transport journey and interchange. Definition and calculation of modal choice, share and shift. Analysis of public policy for sustainable mobility. Urban governance, citizens' participation and transport policy.

Representative References

- ▶ B. MONTULET, M. HUBERT, P. HUYNEN. *Etre mobile. Vécus du temps et usages des modes de transport à Bruxelles*. Bruxelles, Publications des Facultés universitaires Saint-Louis, 210 p., **2007**.
- ▶ B. MONTULET, P. HUYNEN, M. HUBERT. *Belgium, a Society of Commuters* in N. SCHNEIDER, G. MEIL (Eds) *Mobile Living Across Europe I. Relevance and Diversity of Job-Related Spatial Mobility in Six European Countries*, Opladen & Farmington Hills, Barbara Budrich Publishers, pp. 269-304, **2008**.
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- ▶ M. HUBERT, F. DOBRUSZKES, C. MACHARIS. *Mobility within, towards, out of and around Brussels*, in *Brussels Studies*, CFB 1, pp. 1-15, **2009** (<http://www.brusselsstudies.be>)

Partnership

- ▶ EU
- ▶ IRIB

Products and Services

- ▶ Qualitative research
- ▶ Questionnaire survey
- ▶ Consultancy on public policy and mobility practices

KEY WORDS

Daily mobility
Job mobility
Travel behavior
Family
Car infrastructure
Sustainable mobility policy

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Sustainable Mobility and Network Planning

SENIOR SCIENTISTS:

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- ▶ Michel BEUTHE

Research Field and Subjects

Modal choice analysis and spatial planning of intermodal platforms, mainly for freight transportation. External costs analysis (air pollution, traffic congestion, etc.) and analysis of the transportation policies impact (internalization of external costs, taxation, subsidies to intermodal transportation, etc.) on sustainable development. Evaluation of Social Return on Investment. Software modelling for multimodal freight transportation in the European spatial networks (NODUS GIS model).

Representative References

- ▶ O. JONKEREN, B. JOURQUIN and P. RIETVELD, *Modal-split effects of climate change: The effect of low water levels on the competitive position of inland waterway transport in the river Rhine area*, Transportation Research A, In Press, Corrected Proof, Available online 28 February **2009**.
- ▶ S. LIMBOURG and B. JOURQUIN, *Optimal rail-road container terminal locations on the European network*, Transportation Research E, Vol 45, pp 551-563, **2009**.
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- ▶ S. LIMBOURG and B. JOURQUIN, *Rail-Road terminal locations: aggregation errors and best potential locations on large networks*, European Journal of Transport and Infrastructure Research, Vol 7, n°4, pp 317-334, **2007**.
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- ▶ S. LIMBOURG, *Planification stratégique de systèmes de transport de marchandises en Europe*, Ph. D. Thesis, **2007**.
- ▶ M. BEUTHE, *Intermodal freight transport in Europe*, in T. Leinbach and C. CAPINERI (ed.) *Globalized freight transport*, Edward Elgar, **2007**.
- ▶ B. JOURQUIN, P. RIETVELD and K. WESTIN, *Performance of transport networks*, in B. JOURQUIN B., P. RIETVELD and K. WESTIN (eds.), *Toward better performing transport networks*, Routledge, Taylor and Francis Group, **2006**.

Awards

S. Limbourg Prize of the French research programme PREDIT (2007) and Fredrich-List prize (2008) for her thesis « *Planification stratégique de systèmes de transport de marchandises en Europe* »

Funding

- ▶ European Commission,
- ▶ BELSPO
- ▶ Région wallonne
- ▶ Plan Marshall

Partnership

- ▶ Udelft
- ▶ UA
- ▶ FNDP
- ▶ Vrije Universiteit Amsterdam
- ▶ UHasselt
- ▶ UGent
- ▶ VUB
- ▶ ULB
- ▶ Bureau belge du plan
- ▶ VITO

Specific Tools & Main Equipment

Fast computers

Products and Services

Contractual applied research on transport, computer software for transport multimodal analysis.

KEY WORDS

Multimodality
Intermodal platforms
Modal choice
Transport chains/lines
Benefit analysis
Transport externalities

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Accessibility of public areas and buildings open to public by the ICT for disabled and elderly people

SENIOR SCIENTISTS:

- ▶ Michel MERCIER
- ▶ Michel GRAWEZ
- ▶ Geneviève BAZIER

Research Field and Subjects

The aim is to develop a method to improve the accessibility of public areas and buildings open to public by people with disabilities (including aged people), with a view to increase their well-being and social participation.

In this sense, the little demands of federal and regional legislations and the weakness of the “technological culture” are two major difficulties which need to be faced.

In a transversal approach public health, ergonomics, economy and social economy, political philosophy and ICT are articulated to produce a participative method involving the people concerned and their organisations, to contribute to setting up a global accessibility plan. In the longer term the aim is to improve legislations and standardisation for a better accessibility.

Two pilot experiences have been developed:

- use of ICT for developing the accessibility for blind people in the main shopping street of Namur
- use of ICT for developing the accessibility of the new building of Sciences Faculty of the University of Namur

This project is based on researches and competences of the Department of psychology – Faculty of Medicine – University of Namur, specialised in the field of disability.

Funding

“First spin off”, DG 06, Région wallonne

Partnership

- ▶ EO-EDPS (Lyon)

Products and Services

- ▶ Expertise/consultancy in setting up accessibility in public areas and buildings open to public, for people with disabilities (including aged people by ICT).

KEY WORDS

ICT
Disability
Non discrimination
Social participation

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Participatory Cartography and Land Planning

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► Françoise ORBAN-FERAUGE

Research Field and Subjects

With the aim of easing communication and mutual understanding between marginalized communities and decision-makers, an original methodology has been set up based on participatory cartography. Through integration of information from public and private sources, the georeferencing and modelling of social, environmental and economical data helps to better grasping the perspectives and expectations of all stakeholders, with a view to promoting equity and social justice within a co-responsible sustainable development framework.

The research is specifically devoted to Southern Countries, mainly in the context of tropical deforestation, urban agriculture and solid waste management. However, it has been validated and made replicable in the North. Widely interdisciplinary, the research focuses on the close interaction between biophysical and socio-economical variables that address the main challenges of today's environmental fringes.

Technically, mental map encoding procedures, satellite image processing, modelling algorithms and thematic mapped outputs have been implemented jointly by the Communities, Scientists, Politics and Private sector in a quadripartite partnership to better serve the objective of sustainable Land Planning .

Representative References

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- R. ESQUILLO-IGNACIO, A. IGNACIO, F. ORBAN-FERAUGE. *GIS as a tool for a participative and comprehensive land planning. A case study: Community resources management in Central Mindanao (Philippines)* in *RUAF Journal*, number 5, December, pp 31-32, 2001.
- F. ORBAN-FERAUGE, J. LAGO, D. ACHAS, J-P VANHOUDENHOVE, A. IGNACIO. *GIS-based Community Mapping as a Tool for Environmental Resource Management Planning in Barangay Bugo, Cagayan de O*, in proceedings of the Conference on projects review of Xavier University, Cagayan de Oro, Philippines, June 20, 2003.

- F. ORBAN-FERAUGE, B. DENIL, J.P. VANOUUDENHOVE. *GIS integration of Community Knowledge into Urban Planning for Food Security* in *Asia Urbs Magazine European Union*, 4 p., December 2003.
- F. ORBAN-FERAUGE, P. DEFOURNY, A. IGNACIO. *Pour une gestion participative des ressources forestières aux Philippines*. CIUF, Echo-Sud, pp. 6-7, mai 2004.

Awards

- First award at the GSDI (Global Spatial Data Infrastructure) International Conference « A tool for reducing poverty », Santiago de Chile, November 2006, in collaboration with USLS, Bacolod, Philippines for the « Best Poster in Joint Research applied to Participatory Management of Urban Waste and Landfill Rehabilitation ».
- Signum Lasallianum award received in May 2007 at University of Saint La Salle Bacolod Philippines for « significant contribution to the educational mission of La Salle during the past 12 years of collaboration with USLS through EU, CUD, NGOs and various foundations funded projects through co-development, bridging technology with social advancement and generating hope and synergy among many international communities and partners ».

Funding

EU (EuropeAid), CUD, NGOs

Partnership

- ESSC, Ateneo de Manila University, Philippines
- USLS university, Bacolod, Philippines
- XU university, Cagayan de Oro, Philippines
- UCL, Belgium
- FSAGx, Belgium

Main Equipment

GIS laboratory (Arc View and Arc Gis 9.1)

Products and Services

- ▶ GIS Mapping and Modelling Land planning Data from various sources
- ▶ Participatory Cartography Methods

KEY WORDS

Participatory Cartography
Land planning
Geographical Information System (GIS)
Cooperation
Community Development
Community Empowerment
Governance

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Population changes in developing countries

SENIOR SCIENTIST:

▶ Bruno SCHOUMAKER

Research Field and Subjects

This research deals with the population dynamics, mainly in developing countries. Trends and determinants of fertility behaviour in Africa are studied as the determinants and consequences of international migration between Africa and Europe. The studies are based on the collection and analysis of survey data. Longitudinal surveys on international migration in DR Congo and in Belgium have been recently undertaken. Previous research focused on internal migration in Burkina Faso.

Representative References

- ▶ S. HENRY, B. SCHOUMAKER and C. BEAUCHEMIN, *The impact of rain-fall on the first out-migration: a multilevel event history analysis in Burkina Faso*, *Population and Environment*, 25, 5, 423-460, **2004**.
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- ▶ B. SCHOUMAKER, B. DABIRE and B. GNOUMOU-THIOMBIANO, *Collecting community histories to study the determinants of demographic behaviour. A survey in Burkina Faso*, *Population-E*, 61, 1-2, 71-97, **2006**.
- ▶ C. BEAUCHEMIN and B. SCHOUMAKER, *Are migrant associations actors in local development? A national event-history analysis in rural Burkina Faso*, *World Development*, 37, 12, 1897-1913, **2009**.

Funding

- ▶ European Union
- ▶ French Ministry of Foreign Affairs
- ▶ Hewlett Foundation

Partnership

- ▶ Institut National d'Etudes démographiques (France)
- ▶ University of Maastricht (Netherlands)
- ▶ University of Kinshasa (DR Congo)
- ▶ University of Ouagadougou (Burkina Faso)
- ▶ University of Sussex (UK)

Main Equipment & Specific Tools

- ▶ Computers

Products and Services

- ▶ Demographic and social surveys (data collection and analysis)

KEY WORDS

Population dynamics
Migration
Developing countries

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Sustainable Economic and transport geography

SENIOR SCIENTISTS:

- ▶ Isabelle THOMAS
- ▶ Dominique PEETERS

Research Field and Subjects

The research focuses on optimal localisation of human activities and their consequences on the spatial environment.

The research aims also at the development of methods, models, tools for decision making in land use planning and transport modelling, accessibility measurement, transport choice models. Alternative transport mode choices (for passengers or freight) for sustainable communities/cities/regions are also investigated. The last research field concerns housing spatial disparities: prices, rents, modelling in a sustainable context.

Representative References

- ▶ C. DUJARDIN, I. THOMAS, H. TULKENS. *Quelles frontières pour Bruxelles ? Reflets et Perspectives de la Vie Economique*, Tome XLVI 2007/2-3, pp 155-176, **2007**.
- ▶ D. PEETERS, I. THOMAS. *Location of Public Services: From Theory to Application* in L. SANDERS *Models in Spatial Analysis*, Iste, Hermes Science and Lavoisier Company, pp. 73-96, **2007**.
- ▶ I. THOMAS, P. FRANKHAUSER, M.L DE KEERSMAECKER. *Fractal dimension versus density of the built-up surfaces in the periphery of Brussels*. *Papers in Regional Science*, 86 :2, 287-307, **2007**.
- ▶ D. PEETERS, I. THOMAS. *Network autocorrelation*. *Geographical Analysis* (forthcoming) **2009**.
- ▶ I. THOMAS, A. VERHETSEL, F. WITLOX. *Incorporer l'espace dans la modélisation du choix de destination : le cas de 4 villes flamandes*. *Cybergeo : European Journal of Geography*, paper 452, 10 p. **2009**.
- ▶ G. VANDENBULCKE, T. STEENBERGHEN, I. THOMAS. *Mapping accessibility in Belgium: a tool for land-use and transport planning?* *Journal of Transport Geography*, 17, 39-59. **2009**.
- ▶ A. VERHETSEL, I. THOMAS, M. BEELEN. *Commuting behaviour in the Belgian metropolies, or the power of the Alonso-Muth model*. *Journal of Transport and Land Use* (forthcoming) **2009**.

Funding

- ▶ FRS-FNRS
- ▶ Belspo
- ▶ EC
- ▶ ANR (France)
- ▶ Région Wallonne
- ▶ MET

Main Equipment & specific Tools

Statistical and SIG professional softwares

Products and Services

Support for local and regional decision making in terms of spatial choices (optimal locations, transportation network)

KEY WORDS

Optimal location
 Accessibility
 Mobility
 Regional analyses
 Spatial modelling
 Land planning
 Urban
 Periurbanisation
 Spatial econometrics
 Statistical mapping

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Sustainable Agriculture in the Old Cotton Area of Mali

SENIOR SCIENTISTS:

- ▶ Catherine GUIRKINGER
- ▶ Jean-Philippe PLATTEAU

Research Field and Subjects

The project is aimed at a better understanding of the poverty trap that seems to exist in the old cotton zone of Mali (districts of San, Koutiala, and Sikasso). Farms in this area traditionally combine the cultivation of cotton and foodstuffs. Yet, cotton yields show a dramatic tendency to decline and, as a result, the number of farmers who give up this cash crop is increasing. It is therefore essential (i) to identify the mechanisms that underlie this situation; (ii) to identify the main factors that cause the poverty trap; (iii) to compare the characteristics of the farmers who give up cotton cultivation to those of the farmers who do not, and (iv) to examine the role of the parastatal in charge of distributing modern inputs and marketing output (the Compagnie Malienne des Textiles, or CMDT). Data have been collected in 2006-2007 and another round is planned for year 2010 so as to dispose of a panel. Results show three areas of major concern: the severe credit market imperfections that cause farmers to under-apply fertilizers to their lands, the lack of profitable alternatives in water-scarce areas, and important failures of the CMDT.

Representative References

- ▶ C. GUIRKINGER, AND J-P PLATTEAU. *Transformation of the Family Under Rising Land Pressure : A Theoretical Essay*. Centre for Research in the Economics of Development (CRED), Namur.

Funding

- ▶ Agence Française de Développement (AFD)
- ▶ Commission Universitaire de Développement (CUD)

Partnership

- ▶ University Mande Bukari (Bamako)

Products and Services

Derive policy implications from the study that enable us to offer policy advice to official agencies concerned with the problem under scrutiny. This takes the form of feedback through workshops and seminars both in Bamako (under the aegis of the university Mande Bukari and the AFD-Mali) and Paris (under the aegis of the AFD).

KEY WORDS

Land scarcity
Land degradation
Cotton cultivation

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Access to information on plant genetic resources for food and agriculture

SENIOR SCIENTISTS:

- ▶ Maria IGLESIAS
- ▶ Caroline KER

Research Field and Subjects

The research addresses the issue of the intellectual property on plant genetic resources and aims at assessing its impact on agricultural practices and their subsequent effect on biodiversity, on development objectives and the right to food.

Notably the research aims at assessing the impact of intellectual property right on small-scale farmers and on the farmers-seed system. As a matter of fact, the expansion of intellectual-property-based commercial seed system in replacement of farmers seed systems, might uniform the cultures, and cause the disappearance of local landraces and a loss of biodiversity. Such phenomenon might deprive humanity from means to adapt its agriculture to environmental changes.

Representative References

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- ▶ M. IGLESIAS, C. KER. *The intellectual commons: from software to biotechnologies*. Conference for the 30th Anniversary of the CRID, Namur, **2010, January 21**.

Funding

- ▶ FSR
- ▶ Contrats de recherche externe

Partnership

- ▶ Collaboration with Biodiversity International on the writing of an essay on the FAO's
- ▶ International Treaty on plant genetic resources for food and agriculture

KEY WORDS

International treaty
FAO
Commons
Open access
Databases
Information

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Adoption of Technical Innovations in the Peruvian Highlands

SENIOR SCIENTISTS:

- ▶ Jean-Philippe PLATTEAU
- ▶ Vincenzo VERARDI

Research Field and Subjects

The project explores the determinants of adoption by poor farmers specialized in milk and cheese production of the technical innovations that are available in remote and mountainous Andean communities (in Cajamarca province). These technical innovations are aimed at enhancing productivity and better conserving natural resources (pastures). A major finding of the study is that, once information is adequately controlled, credit market imperfections are a major hurdle, which slows down the adoption of innovations. The credit constraint operates both on the demand and supply sides of the innovation market, because the innovation suppliers are also wealth-constrained.

KEY WORDS

Innovation
Adoption
Herding
Food security
Poverty

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Representative References

- ▶ I. BONJEAN, J.P. PLATTEAU, AND V. VERARDI. *Two-Sided Wealth Constraints and Innovation Adoption Under a Grassroots Market-Based Extension System*. Working Paper, Centre for Research in the Economics of Development.

Funding

- ▶ CRED
- ▶ ITDG –Soluciones Practicas, Lima (Peru)

Products and Services

Derive policy implications from the study that enable us to offer policy advice to any interested agency. In particular, this takes the form of feedback with the NGO partner, ITDG –Soluciones Practicas.

Organic food production and integrated farming

SENIOR SCIENTIST:

▶ Pierre VAN CUTSEM

Research Field and Subjects

The research focuses on the study of plant polysaccharides, among which pectin from the cell wall. It was discovered that pectin fragments can bind chitosan fragments and the complex is a powerful elicitor of defence responses in plants. The oligosaccharide complex is a biological pesticide. It has been patented and a spin off has been created to produce and sell the compound.

Patents

- ▶ Anticorps recombinants B3 hautement spécifiques des carraghénanes et des polygénanes. N° Publication 1015765A6, N° dépôt 2003/0593. Clas. internat. C07K C12N
- ▶ Composition comprising oligogalacturonans and polycationic saccharides. Application nr EP06124918.1 - 28/11/2006. PCT – 28/11/2007

Awards

- ▶ Phytofar 2009 Scientific Prize

Funding

Région Wallonne

Partnership

- ▶ FUNDP-URBV
- ▶ FytoFend S.A.
- ▶ INRA-CNRS Dijon
- ▶ CRA-W Gembloux
- ▶ UGent
- ▶ UCL-LLN

Main Equipment

DNA sequencer
HPLC-PAD

Products and Services

Study and production of elicitors for plant defence

KEY WORDS

Oligosaccharides
Pectin
Chitin
Chitosan
Elicitor
Phytopathogens
Plant defence
Biological pesticide
Organic farming
Plasmopara viticola
Phytophthora infestans

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Biological recycling and remediation processes and technologies

SENIOR SCIENTISTS:

- ▶ Spiros AGATHOS
- ▶ Patrick GERIN

Research Field and Subjects

The research aims at solutions for environmental problems in industry and agriculture by activities at the interface of chemical, (micro)-biological and engineering sciences. The research focuses on the design and control of new and improved biological processes and bioreactors, with applications in:

- ▶ Bioremediation processes
 - Development of bioprocesses for the removal of xenobiotics from environmental sites where diffuse contamination is present.
 - Better knowledge and exploitation of the microbial agents to be used in these processes.

▶ Bioconversion processes

Development of bioprocesses for the transformation of industrial, urban and agricultural effluents, including toxic by-products, to convert them either to valuable compounds or to safe-to-dispose residues.

▶ Bioprocess expertise

- Implementation of new biocatalysts (microorganisms, enzymes) and new analytical tools in conventional and innovative bioprocesses.
- Combination of physico-chemical and biological processes into integrated remediation processes.
- Development of molecular tools to monitor microorganisms and enzymes in environmental matrices.

Products and Services

- ▶ Know-how for the design, start-up and operation of bioprocesses dedicated to bioremediation or bioconversion issues.
- ▶ Analysis of polluted samples.
- ▶ Treatability studies and follow-up.
- ▶ Molecular characterisation and identification of environmentally useful micro-organisms.

Main Equipment

- ▶ Bioreactors (from 5 to 2,500 litres)
- ▶ Gas Chromatography (GC)
- ▶ High Performance Liquid Chromatography (HPLC)
- ▶ Fast Protein Liquid Chromatography (FPLC)
- ▶ Crossflow filtration
- ▶ Continuous centrifugation
- ▶ Electrophoresis
- ▶ Spectroscopic and software sensors
- ▶ Workshop for instruments and bioreactors construction
- ▶ Anaerobic glove box

Representative References

- ▶ L. SCHULER, M. NI' CHADHAIN SINE'AD, Y. JOUANNEAU, Ch. MEYER, J. ZYLSTRA GERBEN, P. HOLS, N. AGATHOS SPIROS, Characterization of a Novel Angular Dioxygenase from Fluorene-Degrading *Sphingomonas* sp. Strain LB126, *Appl. Environ. Microbiol.*, 74, p. 1050-1057, **2008**.
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- ▶ I. GEORGE, L. EYERS, B. STENUIT, N. AGATHOS SPIROS, Effect of 2,4,6-trinitrotoluene on soil bacterial communities, *J. Ind. Microbiol. Biotechnol.*, 35, p. 225-236, **2008**.
- ▶ I. MORALES BELPAIRE, P. GERIN, Fate of amyloid fibrils introduced in wastewater sludge, *Water research*, 42, p. 4449-4456, **2008**.
- ▶ H. CABANA, J. P. JONES, N. AGATHOS SPIROS, New tools for new challenges: Innovative use of enzyme technology in micropollutant control, (Abstract IL-027), doi: 10.1016/j.jbiotec.2008.07.1399, *Journal of Biotechnology*, 136/S, p. S604, **2008**.

- ▶ B. STENUIT, L. EYERS, L. SCHULER, N. AGATHOS SPIROS, I. GEORGE, Emerging high-throughput approaches to analyze bioremediation of sites contaminated with hazardous and/or recalcitrant wastes, *Biotechnol. Advances*, 26, 2008, p. 561-575.
- ▶ H. CABANA, J.-L. HABIB JIWAN, R. ROZENBERG, V. ELISASHVILI, M. PENNINCKX, S.N. AGATHOS, J.P. JONES, Elimination of endocrine disrupting chemicals nonylphenol and bisphenol A and personal care product ingredient triclosan using enzyme preparation from the white rot fungus *Corioloropsis polyzona*, *Chemosphere*, 67, 2007, p. 770-778.
- ▶ I. MORALES BELPAIRE, P. GERIN, Factors affecting the fate of active proteins introduced in wastewater sludges: investigation with green fluorescent protein, *WATER RESEARCH*, 41, 8, 2007, p. 1723-1733.

Patents

- P. Demyttenaere, H. Michels, S. Agathos, G. Blackman and P. Ledent (1999). Methods for reducing the effect of detergents upon germination and/or growth of microorganisms. European Patent EPO915061.
- M. Lucas, F. Buchon, B. Gobeaux, V. Mertens, S. Vanhulle, S. Agathos, C.-M. Bols, A.-M. Corbisier and D. Wesenberg (2003). Sustainable process for the treatment and detoxification of liquid waste. World Patent WO03035561.

KEY WORDS

Aerobic and anaerobic bioprocess
 Agrofood waste valorisation
 Bioconversion
 Biogas
 Bioremediation
 Composting & waste management
 Dyes
 Enzymes
 Sludge
 Soil
 Waste water
 Xenobiotics

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Energy labels and information, environmental sensitization campaigns

SENIOR SCIENTIST:

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Research Field and Subjects

Energy labels, environmental information and sensitization campaigns are studied in terms of subsequent energy-related practices.

A focus on environmental sensitization towards children shows the social conditions to which children can be actors of change in their family.

Representative References

- ▶ K. GRAM-HANSSSEN, Fr. BARTIAUX, O. M. JENSEN, M. CANTAERT, "Do homeowners use energy labels? A comparison between Denmark and Belgium", in *Energy Policy*, 35, pp. 2879-2888, **2007**.
- ▶ Fr. BARTIAUX, "Does environmental information overcome practice compartmentalisation and change consumers' behaviours?", *Journal of Cleaner Production*, Vol. 16, n° 11 (July 2008), pp. 1170-1180, **2008**.
- ▶ Fr. BARTIAUX, "Between school, family and media: Do the children carry energy-saving messages and practices?", *Act! Innovate! Deliver!*, ECEEE ed(s), 2009, ECEEE 2009 Summer Study, pp. 1897-1906, **2009**.
- ▶ I. GARABUAU-MOUSSAOUI, Fr. BARTIAUX, M. FILLIASTRE, "Entre école, famille et médias, les enfants sont-ils des acteurs de transmission d'une attention environnementale et énergétique ? Une enquête en France et en Belgique", in N. BURNAY et A. KLEIN (dir.) *Figures contemporaines de la transmission*. Presses Universitaires de Namur, Collection Transhumances IX, pp. 105-120, **2009**.

Funding

- ▶ SPP PS
- ▶ EDF

Partnership

- ▶ U of Aalborg & Danish Building Institute
- ▶ EDF-GRETS, France

Products and Services

- ▶ Conception, realisation and analysis of quantitative and qualitative surveys.

KEY WORDS

Sensitisation
Information
Campaigns
Energy-related practices
Consumers
Children

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Household waste management in Belgian families

SENIOR SCIENTIST:

► Françoise BARTIAUX

Research Field and Subjects

A sociological analysis identifies factors that influence household waste-related practices: these practices include sorting and recycling practices as well as waste production at the household level via shopping habits (as shopping is also packaging shopping). In this analysis, a special attention is given to family interactions.

Representative References

- F. BARTIAUX, "Greening some consumption behaviours: do new routines require agency and reflexivity?", in *Sustainable Consumption, Ecology and Fair Trade*, E. Zaccai (ed.), London, Routledge (Environmental Politics), pp. 91-108, **2007a**.
- F. BARTIAUX, "L'enjeu environnemental en entreprises et chez les consommateurs en Belgique", In *Environnement et sciences sociales. Les défis de l'interdisciplinarité*, C. Gendron & J.G. Vaillancourt (dirs.), Québec, Les Presses de l'Université Laval (Sociologie contemporaine), pp. 353-376, **2007b**.

Funding

- SPP PS
- FNRS

Products and Services

- Conception, realisation and analysis of quantitative and qualitative surveys.

KEY WORDS

Households
Consumers
Domestic waste
Sorting
Grocery shopping

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Energy-related practices in the residential sector

SENIOR SCIENTIST:

▶ Françoise BARTIAUX

Research Field and Subjects

Energy-related practices are studied in the residential sector in Belgium and compared to Danish practices.

A sociological analysis attempts to identify factors that bring about changes in energy-related practices; factors under consideration are: social support, social representations and knowledge on environment and climate change, social norms, gender and generations relations, identity and self-esteem factors, agency.

Representative References

- ▶ F. BARTIAUX, K. GRAM-HANSEN, Socio-political factors influencing household electricity consumption: A comparison between Denmark and Belgium. In Eceee 2005 Summer Study Proceedings: *Energy Savings: What works & who delivers*, pp. 1313-1326, **2005**.
- ▶ F. BARTIAUX, G. VEKEMANS, K. GRAM-HANSEN, D. MAES, M. CANTAERT, B. SPIES, J. DESMEDT, *Socio-technical factors influencing Residential Energy Consumption, SEREC, Final Report*. Published by the Belgian Science Policy Office, Brussels, 222 p., **2006**. Available on http://www.belspo.be/belspo/home/publ/pub_ostc/CPen/rappCP52_en.pdf
- ▶ K. GRAM-HANSEN, F. BARTIAUX, O. M. JENSEN, M. CANTAERT, "Do homeowners use energy labels? A comparison between Denmark and Belgium", in *Energy Policy*, 35, pp. 2879-2888, **2007**.
- ▶ M. MOEZZI & F. BARTIAUX, "Liberating energy analysis", *Saving Energy – Just Do It!*, ECEEE ed(s), 2007, ECEEE 2007 Summer Study, 3, p. 147-154, **2007**.
- ▶ F. BARTIAUX, "Does environmental information overcome practice compartmentalisation and change consumers' behaviours?", *Journal of Cleaner Production*, 16 (11), pp. 1170-1180, **2008**.

Funding

- ▶ SPP PS
- ▶ EEA
- ▶ FNRS

Partnership

- ▶ K. Gram-Hanssen, Danish Building Research Institute and Aalborg University, Denmark
- ▶ M. de Best – Waldhober, Energie Centrum Nederland
- ▶ G. Vekemans, VITO, Belgium

Products and Services

- ▶ Conception, realisation and analysis of quantitative and qualitative surveys.

KEY WORDS

Households
Energy-related practices
Consumers
Energy-saving practices

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Renewable Energy Conversion Systems

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- ▶ Hervé JEANMART
- ▶ Jean-Marie SEYNHAEVE

Research Field and Subjects

Energy conversions have played an increasingly important role in our society since the beginning of the fossil fuels exploitation. The conversion routes are diverse including electricity production, heating, cooling, and transportation. The shift to renewable energy sources brings not only new challenges to the existing routes but also (re-)open other conversion routes. Some of them are studied at UCL in the Institute of Mechanics, Materials and Civil engineering (IMMC).

Experimental, theoretical and numerical activities are combined in order to improve not only the fundamental knowledge in applied thermodynamics but also the technologies in strong interaction with the industry.

The research mainly focuses on:

- the ejector/jet-pump technology in order to convert a low temperature heat source (roughly 80°C-120°C) into a cooling power or to optimize the COP of refrigeration cycles. This research is focused according two tracks: Tritherm cycles based on a supersonic ejector to provide air-conditioning from solar energy or waste-heat; and the use of a two-phase ejector to improve the COP of transcritical CO₂ refrigeration cycles or CO₂ heat pump. The work is conducted both at the system scale (thermodynamic models) and at the component scale (detailed flow models in the ejector)
- Heat Transfer enhancement (study on the potential of nanofluids to improve the convective heat transfer coefficient between a fluid and a wall.
- biomass thermochemical conversion: gasification process for decentralized combined heat and power applications, efficiency and pollutants formation. The two-stage technology developed by UCL and Xylowatt s.a. is continuously improved to reduce the amount of tar in the producer gas cutting down the O&M costs. Detailed models of biomass pyrolysis are developed to improve the fundamental knowledge of biomass thermal degradation.

– the combustion of renewable fuels : internal combustion engines, HCCI (Homogeneous Charge Compression Ignition) engines. While not a renewable fuel, ammonia is also a subject of research as an alternative to hydrogen for transportation applications.

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Funding

- ▶ Region Wallonne
- ▶ EU
- ▶ FNRS
- ▶ Private funding

Partnerships

- ▶ Collaborations with industrial partners in all research topics (e.g. ESE, Xylowatt, Suez, Laborelec, Veolia, Nanocyl).
- ▶ Collaborations with all national research institutions
- ▶ Collaborations with international research actors through European projects or direct contacts (CIRAD, PdM, Natural Resources Canada, etc.)

Specific Tools & Main Equipment

- ▶ Two 400m² laboratories equipped for thermodynamics systems study (IC engines, CHP units, boilers, combustors, etc.)
- ▶ Two-stage experimental gasifier of 100kWth.
- ▶ Supersonic ejector air conditioning cycle (10kW)
- ▶ Experimental channel to evaluate heat transfer coefficient
- ▶ Different measurements tools including PIV, LDV, high speed camera, infrared camera, etc.

Products and Services

- ▶ Expertise in applied thermodynamics
- ▶ Great expertise in experimental facilities design
- ▶ Energy fluxes metrology

KEY WORDS

Thermodynamics
Thermofluid
Ejector/jet-pump
Solar energy
Waste heat conversion
Internal combustion engines
HCCI
Biomass
Gasification
Pyrolysis
Pf-boilers

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Green electronics: SOI technology and ultra-low-power design

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- ▶ Jean-Didier LEGAT

Research Field and Subjects

The reduction of our energy consumption is a global challenge, which has to be dealt with by all industry sectors in a common effort. In the sector of electronics and integrated circuits (ICs), the green electronics trend features two aspects: greening THE electronics and greening BY electronics. The microelectronics laboratory of UCL has been carrying out key research activities in both fields.

Greening THE electronics

The research focuses on lowering energy consumption of electronic devices through:

- Development of Silicon-on-Insulator (SOI) technology;
- SOI circuit design: featuring best-in-class patented circuit blocks to achieve smart power management. Those blocks allow drastic reduction of stand-by power consumption, which is due to leakage current in nanoscale CMOS processes.

Greening BY electronics

The team has a strong expertise with breakthrough patents in ultra-low-power design of both analogue and digital functions towards energy-autonomous systems. The design aims at minimizing both active energy and stand-by power targeting all level of abstractions from technology development and circuit design to system integration. These energy-autonomous systems can then be used both to efficiently manage our energy consumption (building heating or cooling, electricity production and delivery, transportation) and improve healthcare and human security.

Representative References

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- ▶ D. BOL, R. AMBROISE, D. FLANDRE AND J.D LEGAT. *Interests and limitations of technology scaling for subthreshold logic*. IEEE Trans. VLSI Systems 17, in press, **2009**.

Patents

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- ▶ Ultra-low power basic blocks and their uses, US2004/0026760, US patent, 12/02/2004, V. DESSARD S. ADRIAENSEN, D. FLANDRE AND D. LEVACQ.
- ▶ Ultra-low-power circuit, EP2008/055239, European patent PCT, 29/04/2008, D. BOL, D. FLANDRE AND J.-D. LEGAT.
- ▶ Network architecture for wirelessly interfacing sensors at ultra low power, EP2009/050734, European patent PCT, 22/01/2009, G. GOSSET, D. FLANDRE, G. DELMÉE AND B. RUE.

Awards

- ▶ Best paper award from the IEEE Int. Conf. Computer Design 2008 to D. BOL et al. for *Analysis and minimization of practical energy in 45nm subthreshold logic circuits*.
- ▶ Best poster award from the IEEE Int. SOI Conf. 2008 to D. BOL et al. for *Sub-45nm fully-depleted SOI CMOS subthreshold logic for ultra-low-power applications*.

Funding

- ▶ Région wallonne
- ▶ EU
- ▶ FNRS

Partnerships

- ▶ Collaboration with major international industrial (e.g. IBM, TSMC, AMD, ST-M) and academic actors in SOI technologies and circuits, through the SOI consortium (SOI Simply Greener initiative)
- ▶ Participation to European strategic consortia (AENEAS/ENIAC, SINANO/NANOSIL) defining research directions in nanoelectronics
- ▶ Partnership within research projects with European R&D companies in nanoelectronics

Specific Tools & Main Equipment

- ▶ 1000 m² clean room facilities (WINFAB) with major CMOS/MEMS processing equipments
- ▶ Mainstream EDA tools and design kits from major external CMOS foundries
- ▶ 400 m² characterization and test facilities (WELCOME) for nanoelectronics components from devices to systems

Products and Services

- ▶ SOI CMOS and MEMS processing
- ▶ Characterization of nanoelectronics devices
- ▶ Ultra-low-power circuit design expertise
- ▶ Launch of various spin-off companies

KEY WORDS

Microelectronics
Nanoelectronics
Integrated circuits
Ultra-low power
Energy consumption
Circuit design
SOI technology,
CMOS process
Power management
Sensors
Biomedical

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First-Principles Investigation of the Electronic and Optical Properties of Photovoltaic Materials

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- ▶ Xavier GONZE
- ▶ Gian-Marco RIGNANESE

Research Field and Subjects

Fighting global warming calls, among other things, for the development of alternative sources of cheap, abundant, and clean energy. To this end, the use of solar or photovoltaic (PV) cells to replace the use of fossil fuels holds tremendous promise. In this framework, the major challenge is to find cheap and environmentally friendly materials that could be used to produce PV cells with an increased efficiency. Part of the solution relies on mastering the electronic and optical properties of the materials involved.

The research group mainly focuses on the *ab initio* simulation techniques. These techniques allow dealing with systems containing up to a few hundreds of atoms, hence closer and closer to real systems.

Presently, the group is studying the electronic and optical properties of carbon-based nanostructures and transparent conducting oxides. Both play or may play an important role in the development of PV cells.

On the one hand, carbon nanotubes (CNTs) have been integrated in organic photovoltaic devices both as an electron acceptor material and as a transparent electrode.

On the other hand, transparent conducting oxides (TCOs) are an increasingly important component of photovoltaic devices, where they act as electrode elements, structural templates, and diffusion barriers, and their work function controls the open-circuit device voltage. They are employed in applications that range from crystalline-Si heterojunction with intrinsic thin layer (HIT) cells to organic PV polymer solar cells.

The research group is also the central node of the European Theoretical Spectroscopy Facility (ETSF). ETSF is a knowledge center for theoretical spectroscopy carrying out state-of-the-art research on theoretical and computational methods for studying electronic and optical properties of materials.

Representative References

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Funding

- ▶ EU
- ▶ IWT Vlaanderen

Partnership

- ▶ Centre National de la Recherche Scientifique, Institut Néel, Grenoble, France.
- ▶ Centre de l'Energie Atomique, Grenoble, France.
- ▶ Ecole Polytechnique Fédérale de Lausanne, Institute of Theoretical Physics, Switzerland.

Within networks:

- ▶ CeRMiN: Research Center in Micro and Nanoscopic Materials and Electronic Devices, Belgium.
- ▶ ETSF: European Theoretical Spectroscopy Facility

Specific Tools & Main Equipment

- ▶ ABINIT code (package whose main program allows one to find the total energy, charge density and electronic structure of systems made of electrons and nuclei (molecules and periodic solids) within density-functional theory (DFT)).

Products and Services

Expertise offer to researchers, industry, and students in the form of collaborative projects, free scientific software and training.

KEY WORDS

Ab initio computing
Carbon nanotubes
Condensed matter theory
Electronic properties
Numerical simulations
Transparent conducting oxides
Optical properties
Photovoltaic materials

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Energetic, bioclimatic and sustainable architecture

SENIOR SCIENTIST:

► André DE HERDE

Research Field and Subjects

Bioclimatic architecture aims to design buildings combining the available climatic resources and the comfort needs of the occupant.

The research activities concern:

- Design of sustainable buildings, combining the available climatic resources and the comfort needs of the occupants.
- Development of a theory of sustainable architecture, research and modelling of buildings and public spaces, of materials and new materials, and on the water issue.
- Design of buildings in the framework of sustainable architecture.
- Energetic renovation support of tertiary buildings.

Representative References

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Funding

FNRS
IEA - Walloon Government
EC
Federal Government
IBGE
Private companies

Partnership

BBRI (The Belgian Building Research Institute)
CREAT
IGEAT – ULB
Acoustic Laboratory of KUL
LEMA - ULg

Specific Tools & Main Equipment

- Sky and sun simulators + lighting measurement devices.
- Dynamic thermal or hygrothermal simulation software (TRN-SYS, TAS, WUFI).
- Lighting and daylighting simulation software (Radiance, Daysim, HDR).
- Fluid dynamic simulation software CFD (FLUENT, TRNFLOW).

Products and Services

- Design and renovation of buildings taking advantage the climatic resources in order to reduce the energetic demands for heating, cooling and lighting, while achieving high indoor comfort (winter and summer).
- Interdisciplinary approach of the building energy efficiency and training for energetic managers in institutions.
- Creation of pedagogic tools for architects and architects students
- Training for energetic managers in institutions.

KEYWORDS

Bioclimatic and sustainable architecture
Building physics and internal comfort
Daylight
Energy efficiency
Public spaces
Water
Education

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Intelligent (nano)materials and surfaces for environment and energy conservation

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- ▶ Stéphane LUCAS
- ▶ Jean-Jacques PIREAUX
- ▶ Robert SPORKEN
- ▶ Guy TERWAGNE
- ▶ Jean-Pol VIGNERON

Research Field and Subjects

Laboratories from PMR (Research Center in Physics of Matter and Radiation) Physics Department of the University of Namur draw on powerful and modern instrumentation to develop materials, processes, devices and modelling thereof, that are relevant for environment and energy conservation.

Since 1972, Titanium dioxide is intensively studied for its photocatalytic properties. TiO_2 is, for instance, promising for the development of powerful anti-bacterial and self-cleaning coatings, or to build competitive solar cells. One project develops glass and steel substrates plated with TiO_2 coatings to be used inside buildings and as external panels. Most of the efforts are placed on the production of the anatase phase at low process temperature with the magnetron sputtering method.

Recently, ZnO thin layers found other applications than additive for food or UV-filter as transparent conducting oxide films (TCO), material for spintronics and high density data storage. The project aims at modifying and controlling ZnO intrinsic properties by stabilizing its polar surfaces, incorporating impurities, doping with transition metal elements (Co, Mn...)

Third generation photovoltaic cells based on quantum confinement in nanocrystals, or quantum dots (QD), are studied. They should present better efficiency, while being composed of abundant and non toxic elements.

Metal-polymer (oligomer) interfaces play a crucial role in the performances of organic light emitting diodes (OLEDs) and organic photovoltaic (OPVs) cells. The control of these interfaces during their formation (evaporation, sublimation, plasma processes) and the analyses thereof constitute mandatory steps in their preparation, in order to tailor properties – according to theoretical modelling- and to enhance efficiency. The elemental, chemical, structural and morphological properties at interfaces and element diffusion through interfaces are studied (XPS, FTIR, ToF-SIMS, and microscopy) in order to optimize substrate cleaning, layer deposition, device encapsulation cap etc

Quantum chemical calculations are performed to predict electronic properties of new materials; in-house developed computer codes are used for theoretical modelling of optical properties (by solving Maxwell equations in inhomogeneous periodic materials of 1-2-3 dimensions) in order to predict and design optimal geometries for light transfer, extraction or concentration. This is applied, for example, in multilayered ensembles built for electrochrome/thermochrome devices (EC/TC), or to optimize optical emission of nano/micro structured surfaces or interfaces in OLEDs, or to improve the global conversion of solar light in OPVs.

Funding

Région wallonne
Private companies

Partnership

AGC
Arcelor-Mittal

Specific Tools & Main Equipment

Intensive Scientific Computing Facility
RBS, PIXE
XPS, ToF-SIMS
FT-IR, UV-vis-NIR

KEY WORDS

Self-cleaning
Antibacterial
Transparent oxide
Quantum dot
Photovoltaic cell
OLED, surface
Interface
Modelling
Optical properties

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Polymer recycling

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Research Field and Subjects

Plastic materials (polymers) and even more, plastic waste induce more and more concerns in the scope of sustainable development. In link with long term teaching in the field of polymer waste treatment (>15 years) general research fields were explored in recycling and valorisation of polymer scraps and waste.

Primary (in plant) recycling, secondary (after collection and use) recycling, tertiary (by chemical ways) recycling and thermal valorisation (including atmospheric pollution aspects).

- In particular, research projects concerned:
- Characterisation of polymer scraps and waste
- Chemical recycling of isotactic polypropylene into low crystalline (atactic) resin

Representative References

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Funding

Région Wallonne

Partnership

Certech asbl

Specific Tools & Main Equipment

Extruder

KEY WORDS

Polymer recycling
Polymer waste
Chemical recycling

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Catalytic depollution

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Research Field and Subjects

In the recent years environmental legislation has imposed stringent limits on atmospheric emission levels. In particular, the release of chlorinated volatile organic compounds has received much attention. Already in the range of the ppm these compounds constitute a class of atmospheric pollutants amongst the most harmful for the environment and the human health. For instance, polychlorodibenzofuranes (PCDF) and polychlorodibenzodioxines (PCDD) are systematically produced from combustion in incinerators and by those engines that use biomass fuels.

The research team has focused on:

- the development of catalysts able to eliminate chlorobenzene (model molecule of the PCDD) by total oxidation;
- the development of efficient catalysts for the oxidation of different kinds of pollutants:
 - aromatics and chloroaromatics,
 - hydrocarbons : C₄ (CH₄) to C₆,
 - sulfur containing compounds (thiols)
 - nitrogen containing compounds (amines),
 - ozone;
- the elimination of NO_x and SO_x by selective catalytic reduction (several efficient catalytic formulations were developed by the team);
- the recycling of CO₂, to produce chemicals under friendly conditions.

Representative References

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Funding

- ▶ Région Wallonne: DGTRE
- ▶ FNRS
- ▶ FRIA
- ▶ FSR

Specific Tools & Main Equipment

- ▶ Tools for physico-chemical characterisation of catalysts: microscopy and spectroscopy, surface and bulk characterisation
- ▶ Equipment for the preparation of catalysts at the laboratory and at the pilot scales (gram to kilogram).

Products and Services

- ▶ Evaluation of the catalytic performances at the laboratory scale:
 - High throughput : 100 mg of catalysts, maximum temperature of 600°C, flow of 6l/h
 - Micro scale : 1 g of catalyst, maximum temperature of 600°C, flow of 6 l/h
- ▶ Preparation, shaping (extrudates, pellets,...) and characterisation of catalysts (oxides and noble metals, bulk and supported, monoliths) for the depollution of liquid and gaseous effluents.
- ▶ Development of new catalytic formulations
- ▶ Study of the performances of deactivation of catalysts and optimisation of their lifetime.

KEY WORDS

Heterogeneous catalysis
Air depollution
(chloro-)aromatics
Volatile organic compound (voc)
Dioxin
Total oxidation
Denox
Oxide catalysts
Nanoparticles
Cogeneration

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Photovoltaic systems and grids

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Research Field and Subjects

The main research fields concern electrical machines and power electronic converters modelling.

The research team has also expertise in:
isolated photovoltaic systems

- connection to the low voltage grid of decentralized renewable energy sources
- Modelling and simulation of photovoltaic or hybrid systems in view of their analysis and optimization.

Representative References

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Partnership

- ▶ University A. Mira, Bejaia, Algeria
- ▶ University Mentouri, Constantine, Algeria
- ▶ Research center, Gardaia, Algeria
- ▶ EST, Fez, Marocco

Main Equipment

- ▶ Photovoltaic module (c-Si)

Products and Services

- ▶ Analysis and optimization of photovoltaic or hybrid systems

KEY WORDS

Photovoltaic
Modelling
Simulation
Energy storage
Optimization
Irradiation model

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Children, Social Marketing and Culture

SENIOR SCIENTIST:

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Research Field and Subjects

Today's children are tomorrow's consumers. Marketing is omnipresent in our societies. Therefore does it make sense to teach children how to be responsible consumers? Marketing principles can be used to achieve this objective, by promoting healthy food habits among children from 8 to 12. This research belongs to the field of Social Marketing (i.e., the use of Marketing to promote socially-accepted attitudes and behaviors). Another research field aims at developing tastes for Culture among children (through museum visits or through the use of virtual technologies). Both fields target the issue of "responsible consumption".

Representative References

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- ▶ C. DERBAIX and C. PECHEUX, Les mineurs, une ou plusieurs cibles ?, in *Les pratiques publicitaires à la télévision – Quelques questions*, Ministère de la Communauté française de Belgique, 30-39. **2006**.
- ▶ N. GUICHARD and C. PECHEUX, Les enfants et la Publicité, in *Kid Marketing*, EMS éditions. **2007**.
- ▶ K. CHARRY and C. PECHEUX, Enfance, alimentation et publicité : quels rôles pour le marketing ?, *Reflets et Perspectives de la vie économique*, 2, 9-17. **2008**.
- ▶ C. CHARRY and PECHEUX, C. Children, Obesity and Advertising: two experiments to investigate the way to promote healthy food habits, *37th European Marketing Academy (EMAC) Conference*, Brighton, 27-30 May. **2008**.

Partnership

- ▶ Prof. Joël BREE (University of Caen and ESC Rouen) – Projet MARCO (Marketing, Children and Obesity), ANR (Agence Nationale pour la Recherche, France).
- ▶ Prof. Benny Rigaux-Bricmont, University of Laval, Québec, Canada.
- ▶ Prof. Joël Bree, University of Caen and ESC-Rouen.
- ▶ Mehdi Gherbi and Marie Kindt (PhD students, LSM, Mons Campus)

KEY WORDS

Children as consumers
Obesity
Advertising
Culture
New technologies
Social Marketing

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Expanding the limits of (Thin Film) Photovoltaic Technologies

SENIOR SCIENTISTS:

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- ▶ Denis FLANDRE
- ▶ Jean-Pierre RASKIN
- ▶ Laurent FRANCIS
- ▶ Romain DELAMARE
- ▶ Sébastien MICHOTTE

Research Field and Subjects

Major advances have occurred in the past several years as thin film photovoltaic (PV) technologies continue to enter the market for various applications. Critical production issues, such as standardization of absorber- and active layer deposition, still need to be addressed to help to lower the unit cost of module production in large-scale thin film PV manufacturing. Once that has been achieved, the applications that can be pursued using thin film PV technologies include building-integrated photovoltaics (BIPV), roof-top applications and utility-scale applications.

Representative References

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- ▶ A. AFZALIAN, D. FLANDRE. *Physical modeling and design of thin-film SOI lateral PIN photodiodes*. *IEEE Transactions on Electron Devices*, Volume 52, Issue 6, pp. 1116-1122, June **2005**.
- ▶ Q. VAN OVERMEERE, B. NYSTEN AND J. PROOST. *In-situ detection of porosity initiation during aluminum thin film anodising*. *Applied Physics Letters* 94, 074103, **2009**.
- ▶ R. DELMELLE, G. BAMBA, M. SINNAEVE AND J. PROOST. *In-situ monitoring of hydrogen storage in Pd thin film systems*. *Proceedings of the 8th International Symposium on Hydrogen Power - Theoretical and Engineering Solutions*, Lisbon, p. 106, **2009**.
- ▶ O. BULTEEL, R. DELAMARE, D. FLANDRE. *High-Efficiency Solar Cell Embedded in SOI Substrate for ULP Autonomous Circuits*. *Proc. of the IEEE 2009 International SOI Conference*, **2009**.
- ▶ J. PROOST, S. MICHOTTE, R. DELAMARE, Q. VAN OVERMEERE. *In-Situ internal stress measurements : a powerful tool for monitoring the growth of ultrathin films and multilayers*. To be presented at the European Conference on Nano Films, Liège **2010**.

Funding

- ▶ FEDER (EU/RW) grant Minatis

Main Equipment

- ▶ WINFAB: microelectronics clean Room class 100 with CMOS SOI prototype line
- ▶ Custom-built batch-type reactive sputter deposition tool with in-situ optical diagnostics (located WINFAB)

Products and Services

- ▶ Deposition of ultra-pure, custom-specified (ultra-)thin films and multilayers of metals and metallic alloys, (doped) metallic oxides and nitrides.
- ▶ Ultrathin silicon films and substrates
- ▶ Micro and nanostructuring of surfaces and thin films
- ▶ Ion implantation
- ▶ Thin film bonding

KEY WORDS

Thin film photovoltaics
TCO
Reactive and pulsed sputtering
Solar cells co-integrated with electronic circuits
Ultra-thin monocrystalline Si pv cells
Nanostructured Si films
Organic solar cells bulk heterojunctions
BIPV

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A new curative technology to produce chemicals recycling CO₂

SENIOR SCIENTIST:

► Patricio RUIZ

Research Field and Subjects

Contrary to a biological intervention process, it is possible to produce methane exclusively in an inorganic way at room temperature. The formation of CH₄ at such low temperature is an important breakthrough in the knowledge of the role and in the use of CO₂. This can contribute significantly to environmental protection. Methane is the raw material of many hydrocarbons. Our results show that the development of a new technology using CO₂ as a raw material could be considered. The idea that recycling CO₂ to produce chemicals under friendly conditions might well be possible in future can be seriously envisaged already at this stage. The only energy-consuming step is hydrogen production, but hydrogen can be produced from environmentally-friendly processes and renewable energy sources (syn-gas from biomass, fermentation, electrolyse using wind energy or photovoltaic electricity, etc.).

It therefore appears from the results that not only producing methane with zero emission of CO₂ is conceivable but also consuming existing or produced CO₂.

Another keypoint is selectivity. Our results show that, in room temperature conditions, it is possible to reach 100% selectivity in the catalytic methane formation from CO₂ and H₂. No other by-product has been observed.

It is the first time that such an innovative research type is described; It is expected that it results in the development of a new curative technology enabling the production of high added-value chemicals and recycling of the CO₂.

Representative References

- M.A. SORIA, M. JACQUEMIN, N. BION, D. DUPREZ, P. RUIZ. *Catalytic production of methane from CO₂ and H₂ at low temperature: insight on the reaction mechanism*. 6th World Congress in Oxidation Catalysis, Lille, France, July 5-10, **2009**.
- M. JACQUEMIN AND P. RUIZ. *Catalytic production of methane from CO₂ and H₂ at room temperature and atmospheric pressure: a new way to recycle the CO₂ and a basis for the development of processes with 100% selectivity*. IX European Congress on Catalysis (IX Europacat). Salamanca, Spain, August 30-September 4, **2009**.

- M. JACQUEMIN, A. BEULS AND P. RUIZ. *Catalytic production of methane from CO₂ and H₂ at low temperature and low pressure: A new breakthrough in the knowledge to recycle the CO₂*. American Chemical Society (ACS) 239th National Meeting. Division of Fuel Chemistry. CO₂ Capture, Conversion and Utilization. San Francisco, USA, March 22-25, **2010**.

Patents

Catalytic CO₂, Methanation process; Patent deposited on July 07, 2008; MARC JACQUEMIN, NATHALIE BLANGENOIS, PATRICIO RUIZ.

Awards

M. JACQUEMIN, Umicore Prize (Master Thesis), 2008

Partnership

Laboratoire de Catalyse en Chimie Organique, POITIERS, France

Specific Tools & Main Equipment

Catalysts preparation equipment.
Catalytic activity measurements.
Physico-chemical characterisation of catalysts (XDR, XPS, chemisorption, DRIFT, Raman, electronic microscopy, TPR-TPO, etc.)

Products and Services

Applied research.
Preparation of catalysts
Catalytic activity measurements
Characterisation of catalysts
Development of the process

KEY WORDS

Heterogeneous catalysis
CO₂ activation
Methanation
CO₂ recycle
Atmosphere environmental protection

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Soot formation and alternative fuel

SENIOR SCIENTISTS:

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- ▶ Véronique DIAS

Research Field and Subjects

Heavy and stable compounds, produced in engines or industrial processes, are carcinogenic and responsible for soot formation. The formation of soot precursors is studied to understand the soot production and to prevent it.

Moreover, various oxygenated compounds considered like alternative fuel are studied to evaluate their pollutants concentration during their combustion.

- Elaboration of kinetic model of the soot precursors formation in hydrocarbons flames and in oxygenated compounds flames
- Effects of additives on soot formation

Representative References

- ▶ N. LEPLAT, A. SEYDI AND J. VANDOOREN. *An Experimental Study of the Structure of a Stoichiometric Ethanol/Oxygen/Argon Flame*. Combustion Science and Technology, Comb. Sci. And Tech. 180, 3, 519-532, **2008**.
- ▶ X. LORIES, J. VANDOOREN AND D. PEETERS. *Theoretical calculation of the heat of formation of fulvene*. Chemical Physics Letters, 452, 29-32, **2008**.
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- ▶ C. RENARD, V. DIAS, P.J. VAN TIGGELEN AND J. VANDOOREN. *Flame Structure Studies of Rich Ethylene-Oxygen-Argon Mixtures Doped with CO₂, or with NH₃, or, with H₂O*. Proceedings of the Combustion Institute 32, 631-637, **2009**.
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- ▶ V. DETILLEUX AND J. VANDOOREN. *Experimental study and kinetic modeling of benzene oxidation in one-dimensional laminar premixed low-pressure flames*. Combustion, Explosion, and Shock Waves 45, 4, 392-403, **2009**.

Funding

- ▶ AIE-DGTRE
- ▶ FNRS

Partnership

- ▶ Ulg
- ▶ FPMons
- ▶ Ecole Polytechnique de Louvain

Specific Tools & Main Equipment

- ▶ Molecular Beam Mass Spectrometry (MBMS) for premixed flames at low pressure
- ▶ Gas Chromatography (GC)
- ▶ GC/MS coupling
- ▶ Modelling software: Cosilab

Products and Services

- ▶ Measurement of concentrations of stable and radical species throughout the flame front of premixed flammable mixtures
- ▶ Elaboration of kinetic models to predict the formation pathways of CO, NO_x, HAP.
- ▶ Building of reaction mechanisms of hydrogen, hydrocarbons, alcohols, diethers, ammonia, .../oxygen/argon flames

KEY WORDS

Kinetic models
Flame structure
Hydrocarbon fuels
Soot formation
Oxygenated compounds
Soot precursors
CO and CO₂ formation

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Environmental Health

SENIOR SCIENTIST:

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Research Field and Subjects

- Development of new non-invasive biomarkers of renal and respiratory toxicity: validation and application in clinical and epidemiological studies
- Renal effects of the low-environmental exposure to heavy metals in susceptible population strata
- Study of the long- and short-term effects of indoor or outdoor air pollution in children, adolescents and the elderly (PM, ozone, air fresheners, wood and tobacco smoke)
- Evaluation of the threshold of toxicity for the renal effects of cadmium in industrial workers
- Health risks associated with the exposure to chlorination products in tap water and in swimming pools: cross-sectional and prospective studies among schoolchildren and athletes

Representative References

- ▶ A. BERNARD, *Renal and neurological effects of heavy metals*. In: Encyclopedia of Environmental Health. Elsevier **2010**.
- ▶ A. BERNARD, M. NICKMILDER, C. VOISIN, A. SARDELLA, *Impact of chlorinated swimming pool attendance on the respiratory health of adolescents*. Pediatrics. 124, 1110-1118, **2009**.
- ▶ A. BERNARD, M. NICKMILDER, C. VOISIN, *Outdoor swimming pools and the risks of asthma and allergies during adolescence*. Eur Respir J 32, 979-988, **2008**.
- ▶ A. BERNARD, S. CARBONNELLE, X. DUMONT, M. NICKMILDER, *Infant swimming practice, pulmonary epithelium integrity, and the risk of allergic and respiratory diseases later in childhood*. Pediatrics 119, 1095-1103, **2007**.
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- ▶ M. NICKMILDER, C. DE BURBURE, S. CARBONNELLE, X. DUMONT, A. DEROUANE A, A. BERNARD, *Increase of exhaled nitric oxide in children exposed to low levels of ambient ozone*. J Toxicol Environ Health A. 70, 270-274, **2007**.
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Funding

National

- National Fund for Scientific Research
- Federal Government
- Governments of the Brussels and Walloon Regions
- French Community of Belgium
- Spadel SA

International

- Agency for Environmental and Occupational Health Safety (Afsset, France)
- Reach Cadmium Consortium, Brussels
- National Institute of Health (NIH, USA)
- European Union (DGXII and DG SANCO)

Partnerships

Regular collaboration with research teams in USA, Canada, China, Africa and Europe

Main Equipment

- ▶ Automated immunoassays for the determination of proteins in human biological fluids (lung and kidney biomarkers)
- ▶ Non-invasive tests for evaluation the pulmonary function (e.g. exhaled NO)

Products and Services

- ▶ Determination of kidney and lung biomarkers in human or animal biological fluids

KEY WORDS

Biomarkers
Chlorine
Cadmium
Lead
Mercury
Ozone
Particulate matter
Smoke
Asthma
Allergies
Kidney
Children

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Epidemiology of Natural Disasters and Civil Conflicts

SENIOR SCIENTIST:

▶ Debarati GUHA-SAPIR

Research Field and Subjects

The centre has undertaken research and provides evidence based on the burden of disease and health issues arising from natural disasters, with a view to improve preparedness and responses to humanitarian agencies. It also provides training and technical assistance. The main area of research is: analysis of the human impact on natural disaster, conflict and health research.

Representative References

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Awards

- ▶ PETER SAFAR AWARD received for contributions to the science of disaster health; World Association for Disaster and Emergency Medicine (WADEM) Executive Committee, May 2009

Funding

- ▶ European Commission
 - MICRODIS: *Integrated Health Social and Economic Impacts of Extreme Events: Evidence, Methods and Tools*, 2007-2010
 - MICROCON: *Micro Level Analysis of Violent Conflict*, 2006-2010
- ▶ DFID – UK government
 - *Morbidity and mortality in civil conflicts*, 2008-2010
- ▶ USAID
 - *Global database and analyses of disasters*, 1999-2010

Partnership

- ▶ WHO collaborating centre
- ▶ UNDP

Products and Services

- ▶ EMDAT- database
- ▶ EMBIB- database
- ▶ CEDAT- database

KEY WORDS

Natural disaster
Conflict
Epidemiology
Environment
Public health
Statistics

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Environment, Health, Risk and Law

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- ▶ Delphine MISONNE
- ▶ Benoît JADOT
- ▶ Jacques SAMBON
- ▶ François TULKENS
- ▶ Laure DEMEZ

Research Field and Subjects

Researches focus on how law does or should approach and, where necessary, frame new risks to the environment, including risks to human health due to the environment.

Starting from an interest in the prevention and precautionary principles, special attention is paid to risk assessment and risk management procedures, to legal requirements regarding the adequate level of protection and to how balances of interests are supposed to be made by the legislator when environmental and health issues are at stake. The distribution of competences and the fora where decisions are made regarding the appropriate level of protection against such risks is also an issue.

Representative References

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- ▶ D. MISONNE. *The Consideration of Human Health in Environmental Law*. Lextion, Berlin, pp.221 to 234, **2006**.
- ▶ B. JADOT & F. TULKENS. *Le principe de précaution en droit public belge* in M. PAQUES (Ed.), *Le principe de précaution en droit administratif – Precautionary Principle and Administrative Law*, Bruxelles, Bruylant, p. 31-59, **2007**.
- ▶ D. MISONNE. *Le risque environnemental* in *Les ambivalences du risque - regards croisés en science sociale*. Y. CARTUYVELS (Dir.), FUSL, pp. 381- 403, **2008**.
- ▶ B. JADOT & L. VANCRAVEBECK. *Les règles et les procédures régissant l'implantation et l'exploitation des installations de télécommunications mobiles, du point de vue de la protection du cadre de vie et de l'environnement*. Revue de droit communal, 2008/2, pp. 3 to 26, **2008**.
- ▶ J. SAMBON & L. DEMEZ. *La problématique de l'implantation et de l'exploitation des installations de télécommunications mobiles sous l'angle de la jurisprudence du Conseil d'Etat* (avec L. DEMEZ). Rev. dr. commun, liv. 2, 27-47, **2008**.

Funding

Federal and regional public authorities

Partnership

- ▶ IRIB
- ▶ IRIS
- ▶ ELNI
- ▶ SERES

Products and Services

- ▶ Legal advice
- ▶ Drawing up legislation
- ▶ Master's degree on Environmental Law and Country Planning Law
- ▶ Seminars and conferences

KEY WORDS

Environment
Law
Policy
Health
Healthy environment
Human right
Risks
Precaution
Risk assessment
Risk management
Level of protection
Mobile phones
GMO

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Nanotoxic: Effect of manufactured nanoparticles on human health

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- ▶ Stéphane LUCAS
- ▶ Joseph DELHALLE
- ▶ Bernard MASEREEL

Research Field and Subjects

In the coming years, products based on nanotechnology are expected to impact nearly all-industrial sectors and will enter the consumer markets in large quantities. However, the unique physicochemical properties of manufactured nanomaterials, that make them attractive for manufacturers, arises concerns about their potential adverse effect on human health and the environment.

Currently, there is a limited understanding at present of the correlation between nanomaterial physicochemical properties and biointeractions. Thus, research is needed to determine the dependence of physical and chemical properties on nanomaterial behaviour.

"Nanotoxic" is an interdisciplinary research platform based at the University of Namur that includes chemists, physicists, biologists, and pharmacists whose joint effort allows to develop toxicity assays for nanomaterial safety assessment. Particular attention is given to *in vitro* testing assays in order to comply with new EU policies on cosmetics (Council Directive 2003/15/EC) and chemicals (REACH) that promote the use of alternative methods to animal testing. Since current *in vitro* test methods are likely to be influenced by nanoparticle-specific properties, an extensive characterization of nanoparticle properties and validation of assay systems are performed.

The chemists and physicists of the platform have gained an outstanding expertise in nanosciences and nanotechnology through their participation in various high level research programs leading to the set up of adapted methods for nanoparticle characterization (e.g. size, size distribution, shape, elemental composition, crystallography, surface area and surface chemistry).

One of the assets of the Nanotoxic platform is the use of engineered tissues mimicking the design and the function of normal human tissues, an important step forward for regulatory toxicology (and much more realistic than cell cultures). Those *in vitro* tissue models include skin, lung and gut that constitute the main potential routes of contact with nanoparticles. In addition, animal studies are carried out to perform subchronic or chronic exposures that are limited with *in vitro* studies but also to monitor the fate of nanomaterials from their entry into the body, the changes they undergo and their final excretion or storage in the body.

Representative References

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- ▶ K. VAN HOECKE, KA. DE SCHAMPHELAERE, P. VAN DER MEEREN, S. LUCAS, CR. JANSSEN. Ecotoxicity of silica nanoparticles to the green alga *Pseudokirchneriella subcapitata*: importance of surface area. *Environ Toxicol Chem.* 27(9): 1948-57, **2009**.
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Patents

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- Lucas S. Radioactive device 2006, WO2006063418, WW

Funding

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Partnership

The FUNDP-Nanotoxico platform is a validated supplier of the Institute for Reference Materials and Measurements Reference Material Unit (IRMM-European Commission-Joint Research Centre) for nanoparticle characterisation via centrifugal liquid sedimentation and electron microscopy.

Main Equipment & Specific Tools

Applied Biosystems 7900 HT real time RT-PCR for studying gene expression.

2 MeV Tandetron linear accelerator (Altais) for nuclear reactions based spectroscopy.

Field Emission Gun - Scanning Electron Microscope JSM-7500F / Jeol (resolution 0.6 nm) with EDX detector.

CPS 2400 Disc Centrifuge for nanoparticle size analysis.

Products and Services

Trace element detection or biopersistence studies by Particle Induced X-ray emission (PIXE) analysis.

Nanoparticle size distribution measurements using the differential sedimentation method.

KEY WORDS

Health safety
Nanomaterials
Toxicity
Physico-chemical properties

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Disasters and health

SENIOR SCIENTIST:

► Emmanuelle ZECH

Research Field and Subjects

Assessment of the human health, in particular of the impact of a major accidental disaster on the mental, physical and social health of the population that was involved in the disaster.

Representative References

- A. VERSPORTEN, E. ZECH, E. DE SOIR & H. VAN OYEN, *Etude de l'impact de la catastrophe de Ghislenghien sur l'état de stress post-traumatique et sur la santé de la population*. Reports Nr. 2006-025. Institut scientifique de Santé Publique, Bruxelles, **2006**.
- E. DE SOIR, E. ZECH, A. VERSPORTEN, H. VAN OYEN, R. KLEBER, O. VAN DER HART & J. MYLLE, *Prédiction de l'ESPT lors d'une catastrophe technologique*. *Stress et Trauma*, 8(3), 211-224, **2008**.
- A. P. R. VERSPORTEN, E. DE SOIR, E. ZECH & E. VAN OYEN, *A longitudinal study on the Ghislenghien disaster in Belgium: strengths and weaknesses of the study design and response rate*. *Archives of Public Health*, 67, 116-127, **2009**.

KEY WORDS

Epidemiology
Mental health
Physical health
Post-traumatic stress disorder
Life style
Social functioning
Psychosocial help

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Funding

SPF Ministère de la santé, sécurité de la chaîne alimentaire et environnement

Partnership

- Institut scientifique de Santé Publique, Section épidémiologie
- Ecole Royale Militaire, Département des Sciences du comportement, Centre pour l'étude du stress et du trauma

Impact of poverty on environmental degradation in the Indian Himalayas

SENIOR SCIENTIST:

▶ Jean-Marie BALAND

Research Field and Subjects

This project studies the economic determinants of forest degradation owing to firewood collection in Nepal and in India. The main focus is on the link between poverty and deforestation. Since many households collect firewood and fodder for own use, the project ought to distinguish the direct wealth effects from the indirect opportunity cost effects of allocating time to firewood collection. Although the net effect is negative, it is rather negligible. Indeed, a 10% increase in collection times reduces collection by 0.2% alone. The impact of forest degradation on living standards has been limited to date, and the results apply both to India and to Nepal. The introduction of subsidies on alternative sources of energy such as LPG could have very large effects on the reduction of anthropogenic pressures on resources.

The impact of creating local forest zones under the management of a village committee was analyzed. First hand data on measures of the quality and the degradation of forests were used to show that community forests are on average less subject to degradation. This result remains true when considering the best protected State forests known as 'Protected Reserve Forests'. A simple cost-benefit analysis allows us to show that removing the forests' management from the Department of Forests would certainly improve efficiency.

Representative References

▶ J. M. BALAND, P. BARDHAN, S. DAS, D. MOOKHERJEE AND R. SARKAR. *Managing the environmental consequences of growth: forest degradation in the Indian Mid-Himalayas*. Indian Policy Forum, 2006/7, Vol 3, pp 215-266, **2006**.

▶ J.M. BALAND, P. BARDHAN, AND S. BOWLES *Inequality, Cooperation and Environmental Sustainability*. Princeton University Press, **2006**.

▶ J. M. BALAND, P. BARDHAN, S. DAS, D. MOOKHERJEE AND R. SARKAR. *The environmental impact of poverty: Evidence from firewood collection in Rural Nepal*, Economic Development and Cultural Change, forthcoming, **2009**.

Partnership

- ▶ Boston University
- ▶ UC Berkeley
- ▶ ISI, Delhi

KEY WORDS

Biodiversity
Forest conservation

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Welfare impact of the privatization of Common Property resources

SENIOR SCIENTIST:

► Jean-Marie BALAND

Research Field and Subjects

In these projects, the welfare impact of the privatization of natural resources exploited under common access is investigated.

In a first line of analysis, it is shown that, when markets are incomplete, all individuals may be made worse off by privatization, even when the resource is equitably privatized. Such market incompleteness is common in the developing world and can explain the often encountered resistance to efficiency enhancing privatizing reforms, especially in the case of village level landholdings and forests. The advantage of common held property arises because of its superior insurance properties (which tend to provide income maintenance in low states). Sufficient conditions are established under which any feasible insurance scheme under private property cannot ex ante Pareto dominate allocations under the commons.

In the second line of analysis, the dynamic externality involved in the collective exploitation of a renewable resource is analyzed: uses of the resource today limit possible uses tomorrow, and thus lower returns to labour tomorrow. It is shown that, under the dynamic externality, privatization, because it implies a lower use of the resource today, and thus a better preservation of the resource and more employment in the future, can increase the income of all users, even when they are excluded from sharing in the profits made.

Representative References

- J.M BALAND AND P. FRANCOIS. *Commons as Insurance and the welfare impact of privatization*. Journal of Public Economics, 89, 211-31, **2005**.
- J.M BALAND AND K. BJORVATN. *On the distributive impact of privatizing the common*. Working paper, **2009**.

Partnership

- NHH, Bergen, Norway
- UBC, Vancouver, Canada

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Development, Environment and Social Justice in the South

SENIOR SCIENTISTS:

- ▶ Stéphane LEYENS
- ▶ Alexandra de HEERING

Research Field and Subjects

On the basis of different researches conducted in the South (India, DR Congo), the aim is to identify the interrelation of access to natural resources, environmental sustainability, gender affiliation, cultural identity and populations well-being. For instance, it has been shown that the specific role of women in collecting natural resources makes them major actors of sustainable development and has direct impact on their access to social opportunities and to their level of well-being.

The final objective is to contribute to the debate on sustainable development and social justice.

The theoretical framework is mainly constituted of Amartya Sen's theory of social justice and development (the Capability Approach). A participatory approach is adopted for the empirical part of this research.

Representative References

- ▶ S. LEYENS, C. DE WASSEIGE, LANGUY M., *L'apport de la géomatique dans la gestion du Parc National des Virunga : enjeux sociaux et éthiques, et perspectives futures* in LANGUY M., DE MERODE E., *Virunga. Survie du Premier Parc d'Afrique*, Laanoo, **2006**.
- ▶ S. LEYENS, *Justice sociale et conservation de la nature*. *Revue des questions scientifiques*, 179(1), **2008**.
- ▶ A. DE HEERING, *Les castes en Inde. Entre continuité et changement*. *Revue Nouvelle*, n° 11, nov. **2009**.
- ▶ S. LEYENS, *Droits des minorités, droits des femmes en Inde*. *Revue Nouvelle*, n°11, nov. **2009**.
- ▶ S. LEYENS, *Protection de la nature ou développement humain ? Réflexions autour de la théorie du développement d'Amartya Sen*. *Recherches Philosophiques Africaines*, 35, **2009**.
- ▶ A. DE HEERING, S. LEYENS, *Stratégie de développement durable au Sud. Question de genre et approche participative*, in S. LEYENS, A. DE HEERING, *Stratégies de développement durable. Développement, environnement, justice sociale*. Presses Universitaires de Namur, **2010**.

Awards

Tractebel-Environment Prize 2004

Funding

Tractebel Grant, Belgium
FSR Grant, University of Namur
FUCID (NGO, University of Namur)
Wallonie-Bruxelles International
FNRS

Partnership

- ▶ Unité de Géomatique, UCL
- ▶ Rural Development Sciences Department, Arul Anandar College, Madurai (India)
- ▶ Jaharwal Nehru University, New-Delhi (India)
- ▶ PEAK Project, Kodaikanal (India)
- ▶ FUCID, Namur

Main Equipment

- ▶ SPSS Statistics Software

Products and Services

- ▶ Rural Development Project in Southern India (Kodaikanal Hills)

KEY WORDS

Development
Social Justice
Cultural diversity
Gender issues
Castes issues
Capability Approach
Participatory Method
Sen, Amartya
India
DR Congo

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Ideologies and beliefs relative to the natural and cultural environment

SENIOR SCIENTIST:

▶ Vassilis SAROGLOU

Research Field and Subjects

The research focuses on psychology of beliefs, values, and religion.

The main research topics are:

– Understanding food- and environment-related attitudes and ideologies: The role of values and cognitive and emotional dimensions of personality.

– Facing the challenges of multiculturalism and immigrants' acculturation: The ambivalent role of values, religiosity, and religious versus cultural differences.

Representative References

- ▶ V. SAROGLOU & P. GALAND, *Identities, values, and religion: A study among Muslim, other immigrant, and native Belgian young adults after the 9/11 attacks*. *Identity: An International Journal of Theory and Research*, 4, 97-132, **2004**.
- ▶ V. SAROGLOU, V. DELPIERRE & R. DERNELLE, *Values and religiosity: A meta-analysis of studies using Schwartz's model*. *Personality and Individual Differences*, 37, 721-734, **2004**.
- ▶ S. HALLOY, *Le végétarisme : approches exploratoires*. Mémoire de licence en psychologie non publié, Université catholique de Louvain (promoteur: V. SAROGLOU), **2007**.
- ▶ V. SAROGLOU, B. LAMKADDEM, M. VAN PACHTERBEKE & C. BUXANT, *Host society's dislike of the Islamic veil: The role of subtle prejudice, values, and religion*. *International Journal for Intercultural Relations*, 33, 419-428, **2009**.
- ▶ A. MOULAERT, *Végétarisme: personnalité et valeurs de Schwartz*. Mémoire de licence en psychologie non publié, Université catholique de Louvain (promoteur: V. SAROGLOU), **2009**.
- ▶ M. FRIEDMAN & V. SAROGLOU, *Religiosity, psychological acculturation, and well-being among stigmatized and non-stigmatized religious immigrant groups in Western Europe*. *Basic and Applied Social Psychology*, **In press**.

Awards

- ▶ 2005 : Early Career Award, American Psychological Association (APA) - Division 36
- ▶ 2006 Quinquennial Godin Prize, International Association for the Psychology of Religion

Funding

- ▶ FNRS
- ▶ FRFC
- ▶ PSF
- ▶ Wallonie-Bruxelles International
- ▶ Fulbright
- ▶ ARC UCL-Communauté française,
- ▶ FSR-UCL,
- ▶ Metanexus Institute (USA)

KEY WORDS

Vegetarianism
Ecology
Nature
Anthropocentrism
Disgust
Values
Religious beliefs
Cultural differences

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Refugees' mental health and access to care

SENIOR SCIENTIST:

▶ Emmanuelle ZECH

Research Field and Subjects

The research aims at evaluating the mental health of refugees and asylum seekers who have experienced traumatic situations. It also includes the estimation of whether refugees and migrants have the right and real access to mental health care in Europe. The team also works on the implementation and testing of a psychotherapeutic intervention for refugees suffering from post-traumatic stress disorder. The psychotherapeutic intervention involved is the Narrative Exposure Therapy, a short-term treatment that has been developed for people suffering from post stress disorders after war, terror or torture (Schauer, Neuner, & Elbert, 2005).

KEY WORDS

Access to care
Mental health
Refugees
Asylum seekers
Epidemiology

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- ▶ L. DACO & A. DORCHAIN, Qualité de vie, santé et accès aux soins de santé, et santé mentale des personnes demandeuses d'asile ou en situation illégale en Belgique. Mémoire de master en sciences psychologiques, **2008**.
- ▶ P. BELL & E. ZECH, Access to mental health for asylum seekers in the European Union: An analysis of disparities between legal rights and reality. Archives of Public Health, 67, 30-44, **2009**.
- ▶ D. UMUHOZA, La violence organisée et les traumatismes vécus par les demandeurs d'asile et réfugiés survivants du génocide des Tutsis : Etude de leur santé mentale. Mémoire de master en sciences psychologiques, **2009**.
- ▶ F. VANDENBUSSCHE, La thérapie par exposition à la narration. Mémoire de master en sciences psychologiques, **2009**.

Funding

European Refugee Fund: Community Actions 2006

Partnership

- ▶ University of Konstanz
- ▶ University of Oxford

SMART Technologies (smart housing)

SENIOR SCIENTISTS:

- ▶ Marc LOBELLE
- ▶ Gildas AVOINE
- ▶ Kim MENS

Research Field and Subjects

“Smart Technologies” are, for example, *smart housing* or *climatics*, which uses software technology to optimize or minimize energy consumption in habitats, by relying as much as possible on natural sources of lighting, ventilation and heating.

This goal may be achieved by relying on the expertise of the research team in the following research domains:

▶ Networking & distributed systems

With the growth of the Internet, more and more systems are composed of distributed components. This research area covers two complementary research topics:

- tools and languages used to develop *distributed applications*
- protocols and mechanisms used by the *Internet itself*

▶ Dynamically adaptive software systems

In this theme the research team investigates and advances the state-of-the art in software development technology. The problem is mainly addressed from a language engineering angle, focusing in particular on *Context-oriented software technology*. In particular, with its research on the Ambience programming language and AmOS object system, the research group contributes to the emerging research area of context-oriented programming, by studying:

- the conception of a pure context-oriented language for programming ambient software;
- the development of ambient and context-oriented software systems (methodology and tools);
- application domains and scenarios that could benefit from such context-oriented technology.

▶ RFID Security and Privacy

The research group designs distance bounding protocols that aim to thwart relay attacks during authentication processes and is strongly involved in the security analysis of the biometric passport. It published several articles on its security and released a tool to read and check such biometric passports. The tool is already used by many laboratories and institutes. Another research group's challenge is to design authentication protocols that provide both security and privacy. The team addresses the

privacy problem in RFID and works on an adversary model suitable for most of the RFID environments.

Representative References

- ▶ S. GONZALEZ, K. MENS & P. HEYMANS, Highly Dynamic Behaviour Adaptability through Prototypes with Subjective Multimethods. In Proceedings of the 2007 symposium on Dynamic Languages – Companion of the 22nd Annual ACM SIGPLAN Conference on Object-Oriented Programming, System, Languages and Applications (OOPSLA), Montréal, Canada, pp. 77-88, October **2007**.
- ▶ S. GONZALEZ, K. MENS & A. CADIZ, Context-Oriented Programming with the Ambient Object System. European Lisp Symposium (ELS08), **2008**.
- ▶ G. AVOINE, K. KALACH and J.-J. QUISQUATER, ePassport: Securing international contacts with contactless chips. In Gene Tsudik, editor, Financial Cryptography and Data Security - FC'08, volume 5143 of Lecture Notes in Computer Science, pages 141-155, Cozumel, Mexico, January **2008**. IFCA, Springer-Verlag.
- ▶ S. GONZALEZ, Programming in Ambience: Gearing Up for Dynamic Adaptation to Context. PhD Thesis. Département d'Ingénierie Informatique, Université catholique de Louvain, October **2008**.
- ▶ G. AVOINE and A. TCHAMKERTEN, An efficient distance bounding RFID authentication protocol: balancing false-acceptance rate and memory requirement. In Information Security Conference - ISC'09, Pisa, Italy, September **2009**.

Funding

VariBru: Variability in Software-Intensive Product Development. Brussels Government (IRSIB), ICT Impulse Program, 3 years (started September 2007).

Trasilux: Traçabilité dans l'industrie du luxe. Walloon Region, Marshall Programme, 3 years (started January 2010).

Main Equipment

- ▶ Different software tools developed by the research group
- ▶ About 150 computers and 20 servers.
- ▶ A high-end computing cluster
- ▶ Two planetlab nodes
- ▶ Direct IPv6 connectivity to Belnet
- ▶ Gigabit ethernet networks

Products and Services

Ambience is a proof-of-concept language for context-oriented programming, inspired primarily on Slate, Self, Smalltalk and Lisp

KEY WORDS FOR R&D

RFID
Setworking
Smart housing
Operating systems
Software development
Security
Context-oriented programming
Language engineering

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<http://sites.uclouvain.be/security/>

Teleworking and new forms of work organization

SENIOR SCIENTIST:

▶ Laurent TASKIN

Research Field and Subjects

Relying on the spread of information and communication technologies (ICT), new forms of work organization (NFWO) emerge and constitute nowadays a component of a flexible way to manage work that challenge traditional human resource management practices. The research particularly focus on the re-regulation process it involves in the management of remote employees by especially considering two main fields of enquiry: (a) A human resource dimension exploring the management of NFWO and remote employees, namely by focusing on control issues; (b) A strategic dimension exploring how NFWO challenge knowledge transfer.

Representative References

- ▶ L. TASKIN, P. VENDRAMIN. *Le télétravail, une vague silencieuse: Les enjeux socio-économiques d'une nouvelle flexibilité*. Louvain-la-Neuve : Presses Universitaires de Louvain, **2004**.
- ▶ L. TASKIN, V. DEVOS. *Paradoxes from the individualization of human resource management: The case of telework*. Journal of Business Ethics, 62, 13-24, **2005**.
- ▶ L. TASKIN, P.K EDWARDS. *The possibilities and limits of telework in a bureaucratic environment: Lessons from the public sector*. New Technology, Work and Employment, 22(3), 195-207, **2007**.
- ▶ L. TASKIN. *Les enjeux de la déspatialisation pour le management humain: Vers de nouveaux modes de contrôle?* Louvain-la-Neuve: Presses Universitaires de Louvain, **2007**.
- ▶ L. TASKIN. *Développer une perspective «micro» dans l'étude de la fracture numérique : Le cas des nouvelles formes d'organisation du travail comme sources de fractures internes* in A. KIYINDOU (DIR.), *Fractures, mutations, fragmentation : de la diversité des cultures numériques*. 143-160, Paris : Hermes Lavoisier, **2009**.

Partnership

- ▶ Centre de recherche Travail & Technologies, Fondation Travail Université, Namur
- ▶ Teluq, Université du Québec à Montréal
- ▶ Onderzoeksgroep strategische communicatie, Universiteit Antwerpen
- ▶ Institut des Sciences du Travail, Université catholique de Louvain
- ▶ Belgian Teleworking Association

Products and Services

- ▶ Databases on Belgian mobility (especially from the MOBEL national survey) available for remote statistical queries on www.mobel.be
- ▶ Skills in designing, conducting and analysing mobility surveys
- ▶ Skills in modelling mobility
- ▶ Skills in analysing pollutant emissions and energy consumption due to mobility
- ▶ Skills in modelling and analysing the impacts of policy measures on mobility. These policies could also be related to land use and other topics which are linked with mobility behaviours

KEY WORDS

ICT
Teleworking
Human Resource Management
Control
Organisation
Digital divide

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Decision-making tools to support the development of bioenergy in agriculture

SENIOR SCIENTIST:

▶ Annick CASTIAUX

Research Field and Subjects

The thinking concerning sustainability of energy resources have led to interest for energetic opportunities from agricultural products. However, an evaluation of the emerging possibilities is necessary, taking into account the direct and indirect impacts of such new energy supply chains. This research takes into account the externalities of diverse bioenergy routes; it compares them and proposes a decision-making tool to guide the public choice through the different routes following the priorities of Belgian authorities. The research considers the recent recommendations of the European Commission concerning sustainability criteria. It is supported by the Belgian Federal Policy.

Representative References

- ▶ I. BROSE, *Monetization of Environmental Externalities (Emissions) from Bioenergy*. The Annals of "Dunarea de Jos" University of Galati, Fascicle 1 – Economics and Applied Informatics, **2008**.
- ▶ F. VAN STAPPEN, I. BROSE, Y. SCHENKEL, *Sustainability criteria and certification for biomass and bioenergy : State-of-the-art and methodological issues in the Belgian context*. Proceedings of the 17th European Biomass Conference & Exhibition – from research to industry and markets – Hamburg, Germany, **2009**.
- ▶ I. BROSE, F. VAN STAPPEN, A. CASTIAUX, *Articulation of environmental and socio-economic externalities of bioenergy: A qualitative model*. Proceedings of the 15th Annual International Sustainable Development Research Conference – Utrecht, the Netherlands, **2009**.
- ▶ I. BROSE, F. VAN STAPPEN, A. CASTIAUX, *Articulation of environmental and socio-economical externalities from bioenergy: A qualitative model*. University of Vaasa Publication Series. Proceedings of the Corporate Responsibility Research Conference: "Responsible leadership" - University of Vaasa, Finland, **2009**.
- ▶ F. VAN STAPPEN, I. BROSE, Y. SCHENKEL, *Direct and indirect land-use changes issues in sustainability initiatives: state-of-the-art, open issues and future developments*. Biomass&Bioenergy, submitted, **2010**.

- ▶ I. BROSE, F. VAN STAPPEN, A. CASTIAUX, *Articulation of environmental and socio-economical externalities from bioenergy*. Management of Environmental Quality, special issue on "Renewable energy", submitted, **2010**.

Funding

Belgian Science Policy

Partnership

- ▶ VUB, Brussels
- ▶ CRAW, Gembloux
- ▶ KUL, Leuven

KEY WORDS

Bioenergy
Environmental and socioeconomical externalities
Decision-making

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Mutual influence of responsible and innovative behaviours in high-tech firms

SENIOR SCIENTIST:

► Annick CASTIAUX

Research Field and Subjects

Firms are more and more faced with pressures coming from their surrounding stakeholders concerning their responsibility toward society. Some firms see in those pressures new opportunities to develop innovation strategies supporting a double objective: finding new competitive advantages and meeting societal expectations. Other firms consider those pressures as additional constraints limiting their innovation space. In this perspective, the research analyses the behavior of high-technology firms. Those are more than the others faced with the requirement to innovate. Therefore, they are particularly concerned by the optimal management of this paradox between societal expectations and innovation capability. The targeted industries are Information and Communication Technologies (including consultancy in this field) as well as the pharmaceutical industry (including biotechnology firms). The research looks at companies operating in Belgium and intends to include both mature and emerging firms, as well as both large and small firms. Through this study, the goal is to put into evidence a typology of innovative behaviors linked to Corporate Social Responsibility or sustainability practices.

KEY WORDS

Innovation
Corporate Responsibility
High-tech companies

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Representative References

- A. CASTIAUX. *Innovation induced by Corporate Responsibility: A panel of behaviors*, *Proceedings of the CRR conference*. Belfast, **September 2008**.
- A. CASTIAUX. *Responsabilité d'entreprise et innovation : Entre exploration et exploitation*, accepted in *Reflets et Perspectives de la Vie Economique*, **2009**.

Corporate social responsibility – Stakes and tools of Corporate law

SENIOR SCIENTIST:

▶ Yves DE CORDT

Research Field and Subjects

The research gives the corporate legal point of view about corporate social responsibility (CSR). The aim is twofold:

- ▶ to show how the hard law and the soft law governing companies might be the original foundation of CSR and to offer the legal tools to promote CSR and defend stakeholders likely to be mobilised within the firm;
- ▶ to convince companies that taking stakeholders' concerns into account might increase their long term profit, strengthen their success and contribute to their long-lasting development.

In this perspective, the research is aimed at answering some important questions, such as: How to define the legal concept "social interest"? What could be the role of the company's organs (board of directors, management team, audit team, general meeting...) and that of the shareholders in the CSR field? Is there a link between CSR and transparency?

Is corporate governance - as a set of rules and behaviours according to which companies are managed and controlled - a good way to balance the stakeholders's diverse interests in the company (balance between entrepreneurship and control and between performance and conformance; integrity safeguarding mechanisms, transparency and accountability in the decision-making process; incentives for the board and management to guarantee pursuit of original goals, in the interest of the company, of its shareholders and other stakeholders; effective evaluation of performance, risk management and supervision of conformity using agreed procedures and processes; control systems assessment, efficient management of conflicts of interest and abuse of power situations; supporting long-term value creation...)?

Representative References

- ▶ Y. DE CORDT, *La prise en considération des stakeholders dans les codes de corporate governance*, R.P.S., 54-93, **2005**.
- ▶ Y. DE CORDT, *Les lignes de force, Evolution et perspectives du droit des sociétés Anno 2006*, Bruxelles, Bruylant, 1-131, **2006**.
- ▶ Y. DE CORDT, *Le renforcement des droits des actionnaires : vers une démocratie des actionnaires ?*, in *Liber amicorum Jacques Malherbe*, Bruxelles, Bruylant, 319-364, **2006**.
- ▶ Y. DE CORDT et G. SCHAEKEN WILLEMAERS, *La transparence en droit des sociétés et en droit financier*, Bruxelles, Larcier, **2007**.
- ▶ Y. DE CORDT, *L'intérêt social comme vecteur de la responsabilité sociale*, Louvain-la-Neuve, Academia-Bruylant, **2008**.
- ▶ J. MALHERBE, Y. DE CORDT, Ph. LAMBRECHT & Ph. MALHERBE, *Précis de droit des sociétés*, 3^{ème} édition, Bruxelles, Bruylant, **2009**.
- ▶ Y. DE CORDT, *La responsabilité sociale des entreprises – Les enjeux et les outils du droit des sociétés, Reflets et perspectives de la vie économique*, 11-22, **2009**.

Award

- ▶ Prix Pierre Coppens 2005

Products and Services

- ▶ Legal opinions & memos for the Government, companies, institutes, ...
- ▶ General legal advice to the press.

KEY WORDS

Corporate social responsibility
Stakeholders
Corporate law
Corporate governance
Social interest
Capital
Assets
Audit and accountancy
Conflict of interests
Shareholders
General meeting
Transparency
Control

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Environmental Law – Insurance and Tort Law

SENIOR SCIENTIST:

▶ Bernard DUBUISSON

Research Field and Subjects

Research in private environmental law covers the area of European and Belgian law relating to liability and remedying of damage to persons and property as well as ecological impairment. It concerns also coverage methods (insurance, financial guarantees and compensation funds).

The main areas of expertise are:

- ▶ Case studies and identification of the legal system (international, European and internal) which is applicable to a given environmental or town planning situation.
- ▶ Drawing up bills (act or statutory policy) in the search fields.
- ▶ Prospective analysis in view of review a given legislation.

Representative References

- ▶ *Les responsabilités environnementales dans l'espace européen. Point de vue franco-belge* (G. Viney and B. Dubuisson eds), Brussels, Bruylant, 910 pp, **2006**.
- ▶ *La responsabilité environnementale. Transposition de la directive 2004/35 et implications en droit interne* (Centre d'Etude du Droit de l'Environnement – CEDRE – des Facultés universitaires Saint-Louis ed.), Louvain-la-Neuve, Anthemis, 324 pp, **2009**.

Funding

- ▶ European Commission (Fifth Programme)
- ▶ SPP PS (Service Public Fédéral de Programmation – Politique Scientifique)
- ▶ Direction générale de l'environnement et des ressources naturelles
- ▶ Ministère de la Région wallonne (General Direction on Environmental and Natural Resources – Walloon Region)

KEY WORDS

Environmental Law
 Environmental Damage
 Compensation of Ecological Impairment
 Environmental Liability
 Insurance
 Compensation Funds

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Law, governance and sustainable development

SENIOR SCIENTIST:

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Research Field and Subjects

“Law, governance and sustainable development” is an international and interdisciplinary research dynamics. Launched in January 2003, the network now comprises around fifty researchers from the five continents. It explores the stakes and challenges of the contemporary transformations of the modalities of our “living together” in the age of globalisation by crossing different disciplinary perspectives (especially law, social sciences, philosophy and economics). The aim is to review the definition of our individual and collective responsibilities (including responsibility, liability and accountability) amongst ourselves towards both the environment and the future generations.

Representative References

- C. EBERHARD (dir.). *Droit, gouvernance et développement durable*. Paris, Karthala, 376 p, **2005**.
- C. EBERHARD, N. GUPTA. *Legal Pluralism in India*, Special Issue of the Indian Socio-Legal Journal, Vol. XXXI, 148 p, **2005**.
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- C. EBERHARD (dir.). *Law, Land Use and the Environment. Afro-Indian Dialogues*, Pondichery, Institut Français de Pondichéry, 549 p, **2008**.
- C. EBERHARD (dir.). *Traduire nos responsabilités planétaires. Recomposer nos paysages juridiques*, Bruxelles, Bruylant, 764p, **2008**.

Funding

Fondation Charles Léopold Mayer pour le Progrès de l'Homme (FPH)

Partnership

- Université de Montréal
- UQAM
- Université Autonome Métropolitaine
- Mexico
- Pontificia Universidade Catolica do Rio de Janeiro
- IRD
- Université Paris 1 Panthéon-Sorbonne
- Université de Lausanne
- Indian Institute of Technology
- Bombay, National Law University
- Jodhpur, Renmin University Beijing
- Institut Français de Pondichéry
- ULB

Products and Services

Interfaculty course in the third year of Baccalauréat, “Droit, gouvernance et développement durable”.

KEY WORDS

Law
Governance
Sustainable development
Globalization
Responsibility
Intercultural dialogue
Alternatives

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Theories of intergenerational justice, climate justice

SENIOR SCIENTIST:

▶ Axel GOSSERIES

Research Field and Subjects

Research focuses on the various dimensions of justice between generations, such as pensions sustainability, long-term radioactive waste management, our obligations towards future generations regarding biodiversity, etc. Method: exploration of the precise implications of the key philosophical theories of justice in that realm.

KEY WORDS

Political Philosophy
Ethics
Public Policy
Sustainability

SENIOR SCIENTIST

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Representative References

- ▶ *Intergenerational Justice* (ed. with L. Meyer) Oxford: Oxford University Press, 419p., **2009**.
- ▶ *Three models of intergenerational reciprocity*, in A. Gosseries & L. Meyer (eds.) *Intergenerational Justice*, Oxford: Oxford University Press., **2009**.
- ▶ *On Future Generations' Future Rights*, *Journal of Political Philosophy*, 16(4): 446-474, **2008**.
- ▶ *Cosmopolitan Luck Egalitarianism and the Greenhouse Effect*, *Canadian J. of Phil.*, suppl. vol. 31: 279-309, **2007**.
- ▶ *Are Generational Savings Unjust?* (with F. Gaspart), *Politics, Philosophy & Economics*, vol. 6 (2): 193-217, **2007**.
- ▶ *Penser la justice entre les générations, De l'affaire Perruche à la réforme des retraites*, Aubier (Flammarion), Paris, 320p., **2004**.
- ▶ *Historical Emissions and Free-riding*, *Ethical Perspectives*, vol. 11 (1): 36-60, **2004**.
- ▶ *Intergenerational Justice*, in H. LaFollette (ed.), *The Oxford Handbook of Practical Ethics*, Oxford: Oxford University Press, pp. 459-484, **2003**.

Awards

Dopp Prize 2001

Funding

ARC Sustainability Project

Environmental, Rural and Urban Planning Law for a Sustainable Development

SENIOR SCIENTISTS:

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- ▶ Charles-Hubert BORN (SERES)
- ▶ Damien JANS (SERES)
- ▶ Etienne ORBAN de XIVRY (SERES)
- ▶ Bernard DUBUISSON (CPRI)
- ▶ Isabelle DURANT (CPRI)
- ▶ Marc FALLON (CeDIE)

Research Field and Subjects

Interdisciplinary research in environmental and land use planning law for sustainable development aims to study all the institutions and rules of international, EC and Belgian law, tending to direct human activities so as to limit their impact on the human and natural environment and to plan spatial development from the perspective of sustainable development. It is structured into four main axis:

- a) The study of objectives, principles, competences, institutions and instruments common to all of the thematic, such as the division of powers in the federal State, the right to a healthy environment, the precautionary principle, the environmental impact assessment, public participation, environmental liability, or the constitutional policy objective of sustainable development
- b) The study of legal instruments of regional planning and urban planning in the strict sense, namely normative instruments (plans, regulations, permits) and operational instruments (real estate policy instruments, sites to redevelop, ...)
- c) The study of legal instruments of environmental law (regulatory, economic, contractual instruments, etc..) in the various sectors of the environment, themselves divided into two main parts, the law of biodiversity and the law of nuisance
- d) The study of legal instruments aimed at integrating preservation of the environment in the management of rural areas.

The research is part of an interdisciplinary perspective through interaction with the ecological and social sciences in order to improve the relevance of the legal analysis by anchoring it in its ecological and socio-economic context.

This research is primarily conducted, at the UCL, by the Seminar for Urban Planning and Environmental Law (SERES), from the Institute for Interdisciplinary Research in Legal Science (JUR-I). The Centre for Research in Private Law (CPRI) and the Charles De Visscher Centre for International and European Law (CeDIE), from the Institute JUR-I, also conduct more focused research in these areas. This sheet does not cover the activities of the Centre for Philosophy of Law (SRDP), including its research unit "Biodiversity and Reflexive Governance" (BIOGOV), which are the subject of a separate sheet.

Representative References

- ▶ N. DE SADELEER et C.-H. BORN, *Le droit international et communautaire de la biodiversité*, Paris, Dalloz, 780 pp, **2004**.
- ▶ C.-H. BORN, *Guide juridique des zones protégées en Wallonie*, Jambes, Ministère de la Région wallonne, Division de la Nature et des Forêts, 380 pp, **2005**.
- ▶ D. JANS, *Droit de l'environnement et nuisances industrielles*, Bruges, La Charte, 450 p, **2006**.
- ▶ G. VINEY et B. DUBUISSON (dir.), *Les responsabilités environnementales dans l'espace européen : point de vue franco-belge*, Bruxelles, Bruylant, **2006**.
- ▶ F. HAUMONT, *Répertoire notarial. Urbanisme. Région wallonne*, Bruxelles, Larcier, 415 p, **2007**.
- ▶ F. HAUMONT, *Le droit européen de l'aménagement du territoire et de l'urbanisme*, Bruxelles, Bruylant, 392 p, **2007**.
- ▶ Ch.-H. BORN et F. HAUMONT (dir.), *Actualités du droit de la ruralité. Vers une gestion plus durable de l'espace rural ?*, Bruxelles, Bruylant, à paraître, **2010**.

Funding

- ▶ FSR – Fonds spécial de recherche UCL
- ▶ Direction générale de l'Aménagement du territoire (Service public de Wallonie)
- ▶ Direction générale de l'Agriculture, de l'Environnement et des Ressources naturelles (Service public de Wallonie)
- ▶ Service public fédéral de la politique scientifique (BELSPO)
- ▶ EC Commission

Partnership

- ▶ CEDRE (Centre d'études du droit de l'environnement) (FUSL)
- ▶ Other french speaking universities (ULg, ULB, FUNDP)
- ▶ CRIDEAU, Limoges, France (Centre de recherche interdisciplinaire en droit de l'environnement, de l'aménagement du territoire et de l'urbanisme)
- ▶ GRIDAUH, Nantes, France (Groupe de recherche interdisciplinaire en droit de l'aménagement, de l'urbanisme et de l'habitat)

Products and Services

- a) Case studies and identification of the relevant legal regime in international, European and domestic law at a given environmental or urban situation
- b) Preparation of draft legislation and regulations
- c) Writing scientific books and papers
- d) Reviews of legislations and case law
- e) Prospective Analysis for reform of a given legislation
- f) Legal advice and consultation

KEY WORDS

Environmental Law
Regional and Urban Planning
Law of Biodiversity
Right to a Healthy Environment
Integration
Sustainable Development
Rural law
Environmental Liability
Ecological damage

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Territorial development, environment and governance

SENIOR SCIENTIST:

▶ Fabienne LELOUP

Research Fields and Subjects

Two main axes are interconnected:

- the analysis of the local economic dynamics, as based on local and sustainable development
- the analysis of the local public policy and the inherent process of governing in such territories

The research team' capacities:

- theoretical frameworking: how to understand local economic and political development when built on local realities, both in Europe (France, Belgium, Franco-Belgian borderland) or in developing countries (e.g. in Western Africa); territorial development includes economic growth but also sustainability in its economic, social, cultural and environmental aspects since based on a long-term view.
- applied case studies: analysis of the actors dynamics and networking; of their regulation approaches and of the economic impacts of local project, including cross-border areas, preserving local sustainability or long term environmental and socio-economic interactions.

Projects:

- Projet Interuniversitaire de Coopération (CUD), led by professor Marc Mormont (ULG) with the Senegalese University Cheick Anta Diop; the four-year project provides a tool for understanding and supporting the implementation of the Protected Marine Areas in Senegal.
- Expertise in the multi-sector local project « Wallonie-Picarde » and in the prospective network IntelliTerWal and in some local case studies (e.a. les Parcs Naturels Wallons).
- Yearly research WorkingDays on local development and public action, including academic research staff, young doctorate students plus public administration, civil society representatives and political decision makers. Debates on the implementation of local specificities ; on the political leaders' impacts, on the effects of borderland or on the processes of territorial identity.

Representatives references

- ▶ « Savoir, innovation et développement territorial », *Territoire(s) Wallon(s)*, Hors Série (81-91), **2007**.
- ▶ « Les échelles régionales pour penser le territoire et la dépendance au sentier », F. Leloup, L. Moyart, S. Pradella, in A. Faure, J.-P. Leresche, S. Nahrath, P. Muller, *Action publique et changements d'échelles : les nouvelles focales du politique*, éd. L'Aube (71-83), **2007**.
- ▶ « La Région frontalière : vers quels nouveaux modes de développement et de gouvernance ? », F. Leloup, L. Moyart in A.-L. Amilhat-Szary, M.-C. Fourny, *Après les frontières, avec les frontières*, Bibl. des Territoires, éd. L'Aube (38-55), **2006**.
- ▶ « La Gouvernance territoriale comme nouveau mode de coordination territoriale », F. Leloup, L. Moyart, B. Pecqueur, *Géographie, Économie et Sociétés*, vol.7, n°4, décembre 2005 (321-331), **2005**.

Funding

- ▶ CUD
- ▶ FUCaM
- ▶ FNRS – FSR
- ▶ Région wallonne
- ▶ Intercommunale IDETA

Partnerships

- ▶ Laurence Moyart, chargée de cours invitée aux FUCaM, directrice du Centre culturel de Frameries
- ▶ Bernard Pecqueur (professeur et vice-président de l'Institut de Géographie Alpine) et l'UMR pluridisciplinaire PACTE
- ▶ B. Declève (UCL)
- ▶ M. Mormont (ULG – Arlon)

KEY WORDS

Territorial governance
Public policy
Local development
Borderland
Sustainable spatial development

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Environmental Law and Policy

SENIOR SCIENTISTS:

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- ▶ Benoît JADOT
- ▶ Delphine MISONNE
- ▶ Jacques SAMBON
- ▶ François TULKENS
- ▶ Laure DEMEZ

Research Field and Subjects

CEDRE is a university research centre dealing with all issues of environmental laws and policies. It participates in the construction, analysis and teaching of this legal field, be at international, European, federal, regional or local level.

CEDRE's specific areas of interest are:

- the principles of Environmental Law (precaution, polluter-pays principle, prevention, integration, etc.) and sustainable development;
- the legal theory of environmental protection;
- the right to a healthy environment;
- the instruments of environmental protection: permits, impact assessment, quality standards, emission limits, product norms, trading, voluntary agreements, green taxes, etc.;
- the procedural aspects, including participatory procedures, access to information, access to justice, etc.;
- the sectorial aspects: air, waste, products, noise, nature conservation, climate change, electromagnetic fields, contaminated land and industrial pollution laws and policies;
- integrated product policy;
- the enforcement of environmental protection legislation.

Representative References

- ▶ F. OST. *La nature hors la loi. L'écologie à l'épreuve du droit*. Paris, Editions La Découverte, 1995, 370 p, new edition in **2003**.
- ▶ B. JADOT (Ed.). *La participation du public au processus de décision en matière d'environnement et d'urbanisme*. Bruylant, 10 p, **2005**.
- ▶ F. TULKENS. *Nuisances sonores, droits fondamentaux et constitutionnels belges : développements récents*. Revue trimestrielle des Droits de l'homme, pp. 279 à 298, **2005**.
- ▶ D. MISONNE. *The Consideration of Human Health in Environmental Law*. Lextion, Berlin, pp.221 to 234, **2006**.
- ▶ CEDRE-ABEFDATU. *Assainissement et gestion des sols pollués : un cadre légal nouveau*. Bruylant, 287 p, **2007**.
- ▶ B. JADOT & F. HAUMONT (Ed.). *Repertoire Pratique de Droit Belge (R.P.D.B.)*. Verbo «Urbanisme et Environnement», Bruylant, **2008**.

- ▶ J.SAMBON & L.DEMEZ. *La problématique de l'implantation et de l'exploitation des installations de télécommunications mobiles sous l'angle de la jurisprudence du Conseil d'Etat* (avec L. DEMEZ). *Rev. dr. commun*, liv. 2, 27-47, **2008**.
- ▶ CEDRE. *La responsabilité environnementale, Transposition de la directive 2004/35 et implications en droit interne*. Anthémis, 323 p, **2009**.
- ▶ CEDRE. *Acteurs et outils du droit de l'environnement, Développements récents, développements (peut-être) à venir*. Anthémis. 2010.

Funding

- ▶ Federal Science Policy
- ▶ Federal and regional public authorities
- ▶ European Commission
- ▶ FNRS

Partnership

- ▶ IRIB
- ▶ IRIS
- ▶ Environmental Law Network International (ELNI)
- ▶ Abefdatu
- ▶ SERES

Products and Services

- ▶ Legal advice on all Environmental Law issues
- ▶ Drawing up legislation
- ▶ Reviews of legislation and case law
- ▶ Master's degree on Environmental Law and Country Planning Law
- ▶ Seminars and conferences
- ▶ Publications, including a specific Law Journal (with SERES, UCL)

KEY WORDS

Environment
Law
Policy
Precaution
Health
Impact assessment
Responsibility
Rights
Access to Justice
Access to Information
Public participation
Sustainable Development

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International Transfer of Environmentally Sound Technologies

SENIOR SCIENTISTS:

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- ▶ Paul BELLEFLAMME

Research Field and Subjects

This research aims to understand the mechanisms and channels to achieve the successful transfer of environmentally sound technologies to fight climate change from developed countries to emergent and developing countries.

It examines International Agreements on Climate Change, principally the Kyoto Protocol and its mechanisms such as the Clean Development Mechanism (CDM), considered as a main factor to boost technology transfer and diffusion.

The study will provide economic and legal analysis from the point of view of intellectual property rights by reviewing the literature and by empirical work.

Representative References

- ▶ P. BELLEFLAMME. *Patents and incentives to innovate: Some theoretical and empirical economic evidence. Ethical Perspectives: Journal of the European Ethics Network* 13/2; 267-288, **2006**. Reprinted in *Ideas, Innovations and Patents*, C Sri Krishna (ed.) The Icfai University Press: Hyderabad, India, **2007**.
- ▶ P. BELLEFLAMME. *La politique de l'innovation dans l'économie mondiale : quelques questions ouvertes relatives à l'économie. L'Accord ADPIC : dix ans après Regards croisés Europe-Amérique latine*, edited by Bernard REMICHE and Jorge KORS 493-504, **2007**.
- ▶ B. REMICHE. *L'Accord ADPIC, dix ans après : un accord de libre-échange ou d'intégration forcée. L'Accord ADPIC : dix ans après Regards croisés Europe-Amérique latine*, edited by Bernard REMICHE and Jorge KORS 527-542, **2007**.
- ▶ B. REMICHE AND V. CASSIERS. *Lutte anti-contrefaçon et transferts de technologies Nord-Sud : un véritable enjeu. Revue Internationale de Droit Economique* 277- 324, **2009**.

Awards

Prix GDF SUEZ 2008

Funding

GDF SUEZ

Partnership

- ▶ Chaire Arcelor – Technology and law
- ▶ Core - Center for Operations Research and Econometrics
- ▶ Cerna - Centre for Industrial Economics
- ▶ Ecole des Mines de Paris - Mines Paris Tech

Products and Services

The final report will provide recommendations for new regulations on post-Kyoto technology transfer regarding climate change.

KEY WORDS

Developing countries
Environmentally sound technologies
Technology transfer
Kyoto protocol
Cdm projects
Climate change

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GMO, biomedicine and mobile phones: risk policies and democracy

SENIOR SCIENTIST:

► Nathalie SCHIFFINO

Research Field and Subjects

Research focuses on the emergence, formulation and formal adoption of public risk management policies, more specifically as far as GMO, biomedicine and mobile phones are concerned, particularly in Belgium. A comparative approach (across sectors and countries) is promoted. Policies vary considerably in terms of the *goals* they try to attain, the *instruments* they use, the *social groups* towards which they are *targeted*, and the *actors* that are in charge of *implementing* them. Scientific research, patenting (property rights), commercialization of biotechnologies trigger vivid debates and have numerous impacts on our way of living. Comparative public policies analysis allows systematic studying of the connections which developments in GMO, biomedicine and communication technologies create between sciences, market, ethics and society. The purpose is to develop systematic comparisons, especially across sectors in Belgium, applying theories of public policy analyses. Moreover, two main focuses are developed: how democracy deals with (political) crises having to do with these issues, and how representative and participatory logics interact as they regulate such crises. Nowadays, risk policies partly rely on participatory devices (consensus conferences, deliberative polling's, and so on). This intrigues representation's legitimacy and efficacy.

Representative References

- N. SCHIFFINO, F. VARONE (dir.). *Procréation médicalement assistée : régulation publique et enjeux bioéthiques*, Bruxelles, Bruylant, **2003**.
- N. SCHIFFINO. *Biotechnologies et démocratie : statut et évolution de l'expertise dans la prise de décision politique*, in S. JACOB, J.L. GENAR, *Expertise et action publique*, Bruxelles : Editions de l'ULB, Coll. Sociologie politique, **2004**.
- N. SCHIFFINO. *Comment démocratiser la régulation publique des enjeux techniques*, in P. NIHOUL, S. MAHIEU, *La sécurité alimentaire et la réglementation des OGM. Perspectives nationale, européenne et internationale*, Bruxelles : Larcier, **2005**.
- N. SCHIFFINO, F. VARONE. *Régulation politique des biotechnologies : biomédecine et OGM en Belgique et en France*, Gand : Academia Press, Série Sciences et Société, **2005**.

- S. JACOB, N. SCHIFFINO. *Docteur Folamour apprivoisé? Les politiques publiques du risque*. *Politique et Sociétés*, vol. 26, n°2-3 : 45-72. (Coordination du dossier thématique. Présentation du numéro. Les politiques publiques du risque, *Politique et Sociétés*, vol. 26, n°2-3 : 19-26). [<http://www.erudit.org/revue/ps/2007/v26/n2-3/index.html>], **2007**.
- E. MONTPETIT, N. SCHIFFINO. *Policy Mediation of Tensions regarding Biotechnology in France* in E. MONTPETIT ET AL., *The Politics of Biotechnology in North America and Europe: Policy Networks, Institutions and Internationalization*, Lanham : Lexington Books, **2007**.
- N. SCHIFFINO, C. RAMJOUÉ, F. VARONE. *Biomedical Policies in Belgium and Italy: From Regulatory Reluctance To Policy Changes*. *West European Politics*, vol. 32, n°3: 559-585 (2008 IP 1.422; *Ranking: 17/99* (Political Science - Thomson Reuters, 2008 Journal Citation Reports), **2009**.
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Funding

FSRIU for research on mobile phones' regulation

Partnership

- Interdisciplinary collaborations (economy, genetics a.o. – FUCaM & UCL)
- Common research with Laval University

KEY WORDS

GMO
Biomedicine
Mobile phones
Public policies
Regulation
Risk
Democracy

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Law and policy for a sustainable development

SENIOR SCIENTIST:

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Research Field and Subjects

Environmental law draws on different legal disciplines (national law, and European private and public law, etc.) Present research is aimed at determining which legal means are appropriate to protect the environment and avoid further degradation. Emphasis is placed on the role of general principles (precautionary principle and polluter-pays principle in particular) which play an increasing role both in European and national law.

Special attention is also paid to the various forms of social responsibility and legal liability for environmental damages, as provided for by recent European directives.

KEY WORDS

Environmental Law
Liability
Environmental liability
Ecological damage
Precautionary Principle
Polluter-pays Principle
Principle of Prevention

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Representative References

- X. THUNIS. *Fonctions et fondements de la responsabilité en matière environnementale* in *Les responsabilités environnementales dans l'espace européen*, sous la dir. de G. VINEY et B. DUBUISSON, Schulthess, Bruylant, L.G.D.J., pp.25-68, **2006**.
- A. CASTIAUX, S.PONDEVILLE ET X THUNIS. *Les leviers de la politique environnementale et leurs perceptions* in *Rapport analytique sur l'état de l'environnement wallon 2006-2007*, MRW-DGRNE, Namur, pp. 697-713, **2007**.
- X. THUNIS. *Responsabilité civile en matière d'environnement : permanences et transformations* in *Urbanisme et environnement*, Répertoire pratique de droit belge, t. 10, Bruxelles, pp. 1333-1348, **2007**.
- X. THUNIS. *La responsabilité : succès d'un malentendu* in *Tra-duire nos responsabilités planétaires Recomposer nos paysages juridiques*, (dir. C. EBERHARD), Bruxelles, Bruylant, pp. 111-130, **2008**.

Partnership

CEDRE

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Land-use changes: monitoring by remote sensing and integrated modelling

SENIOR SCIENTIST:

▶ Eric LAMBIN

Research Field and Subjects

We specialize in land-use and land-cover change research. We use earth observation by satellite to monitor and model tropical deforestation, forest transitions, and dryland degradation in tropical regions mostly.

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Awards

- ▶ Prix Francqui 2009
- ▶ Foreign Associate of the U.S. National Academy of Sciences
- ▶ Membre de l'Académie Royale des sciences, des lettres & des beaux-arts de Belgique
- ▶ 2009 Sustainability Science Award from the Ecological Society of America

Funding

- ▶ EC FP7
- ▶ Belspo

Partnership

- ▶ Stanford University
- ▶ Humboldt University
- ▶ Joint Research Center, Ispra

Main Equipment

- ▶ Computing for image processing and geographic information systems

KEY WORDS

Land change
Remote sensing
Tropical forests
Drylands

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Quantitative Conservation Biology: laying the scientific foundations of biodiversity conservation decisions

SENIOR SCIENTIST:

► Nicolas SCHTICKZELLE

Research Field and Subjects

Proactive biodiversity conservation and management are difficult without a deep understanding of processes determining species and population viability. Our research aims to study, quantitatively and on model systems, the effect of major perturbations on population dynamics and viability. We model the functioning of animal populations and analyze the link between environmental conditions and population performance. We use mathematical modeling to try and predict the long term effect of plausible scenarios such as the increase of the pressures on the species or, on the contrary, conservation measures.

Research in our team primarily focuses on butterflies and microorganisms. Many butterfly species are indeed good model organisms to study in situ the reaction of species to perturbations in their environment. The study of real populations in nature is nevertheless limited by numerous practical constraints, and hardly allows rigorous experimentation given the many uncontrolled phenomena. The development of microcosms - small artificial worlds inhabited by microorganisms - in the laboratory is an essential complement: with them, it is possible to test specific aspects of the links between populations and their environment. Currently, our research on butterflies focuses on the study of two main determinants of viability: dispersal and habitat quality.

► Dispersal is currently recognized as one of the fundamental processes in the functioning of populations, a fortiori given the increasing habitat fragmentation following human activities. It is a key parameter in the design of ecological networks (e.g. Natura 2000), but poorly known in conservation biology. The bulk of previous studies of dispersal in fragmented landscapes focused on the patterns of dispersal, but the current need lies in the understanding of processes that create these patterns. The aim of our research is to use computer modeling to determine how movement and dispersal behaviors are translated in patterns at the scale of a fragmented landscape.

► Habitat quality has often been ignored or highly simplified in the modeling of dynamics and viability of natural (meta)populations, despite its functional importance. Due to the difficulties of its estimation, its integration is essentially binary: the biotope is either a suitable habitat or an inhospitable matrix. Nevertheless, its variation is in reality gradual according to the various resources needed by the species. To determine habitat quality, it is necessary to measure resources and their influence on population demogra-

phy through its impact on individual performance and fitness. The objective of our research is to establish habitat quality maps from the distribution of the resources necessary to the life cycle of the species and to include them into models of population viability.

Tetrahymena thermophila is an ideal species for experiments with microcosms for several reasons. (1) Even if few studies have focused on ecological and evolutionary aspects, this species is well known because it has been used as a model organism in microbiology for a long time. (2) Because genetically distinct clones can be maintained, studies of the genetic basis of determinants of viability are possible. (3) Owing to the species ability to produce morphologically distinct dispersal morphs, *T. thermophila* allows the direct experimental study of dispersal processes. Selection pressures and constraints acting on life history traits are numerous, and this creates an interdependency between life history traits, very difficult to study in the «real world». The objective of our research is to use *T. thermophila* to jointly study the two determinants of viability studied on butterfly systems: dispersal and habitat quality. Metapopulation systems, built with tubes (habitat patches) linked by pipes (dispersal corridors), allow us to study in detail how the viability depends on: (1) demographic and dispersal strategies by comparing the strains in similar conditions; (2) landscape structure by varying number and spatial configuration of habitat patches and dispersal corridors; (3) habitat quality and its temporal variability (environmental stochasticity) by altering the abundance of food.

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Partnership

- ▶ CNRS
- ▶ MNHN Paris
- ▶ University of Washington, Seattle
- ▶ The Vlinderstichting

Main Equipment

Our research includes both field studies and laboratory studies. In the field we measure, for example, microclimatic conditions (e.g. data loggers) and body temperatures in insects (e.g. thermal probes). We track movements by GPS and make use of GIS-software (Geographic Information System).

In the laboratory, we develop microcosms with artificial populations of *Tetrahymena thermophila*. Equipment mainly includes incubator, biohazard flow hood and a digital imaging station with microscope.

Products and Services

- ▶ Statistical assistance to researchers and industry
- ▶ Decision making assistance for conservation and biodiversity managers

KEY WORDS

Biodiversity conservation
Butterflies
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Population viability analysis
metapopulation
Dispersal
Habitat quality

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