This brochure « Environment and Sustainable Development » has been prepared by the Research Administration Departments of the Académie universitaire Louvain (FUCaM, FUNDP, FUSL and UCL) with the valuable help of a peer review committee composed of:

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- Professor Michel Beuthe – FUCAM, Department of Management – Louvain School of Management,
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- Professor Stéphane Leyens – FUNDP, Department of « Sciences, Philosophies and Societies »,
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Cover: Planet earth waterdrop under a blade of grass. © Thomas Vogel - iStockphoto.
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 multidisciplinarity 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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* 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, 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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WEB SITE
http://www.uclouvain.be/275900.html
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, 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.

Products and Services

Training sessions

KEY WORDS
GDP
Beyond Indicators
Alternative Progress
Measuring

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WEB SITES
http://www.uclouvain.be/275900.html
Sustainability.
Demographic, technological and normative aspects

SENIOR SCIENTISTS:
- David DE LA CROIX
- Raouf BOUCEKKINE
- 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.

Representative References


Funding

ARC “Sustainability”

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

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Raouf BOUCEKKINE
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Axel GOSSERIES
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Tel.: 32 (0)10 47 29 03
Conceptual and Ethical Aspects of Sustainable Development

SENIOR SCIENTIST:
› Bernard FELTZ

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…

Representative References


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

SENIOR SCIENTIST
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Institut supérieur de philosophie (ISP)
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Epistemology of Sustainable Development

**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 theoricians and actors alike put under this concept, and to clarify the issues that lie behind.

**Representative References**


**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 xviiié siècle en Belgique in Histoire urbaine, n° 18, p. 61-76, 2007.

Awards

› 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

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Tel.: 32 (0)81 72 48 12

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.

Representative References


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


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, CEFÉ 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

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- 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


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

KEY WORDS
Pond management
Agriculture
Biodiversity
Stakeholders
Perception

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

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


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

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- 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-RTPCR), oxidative processes (redox status, DNA damage, antioxidative resistance), vitamins and fat metabolism as well as cell metabolic processes (CYP450 activity, ATP content) are measured.

Representative References

- 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.

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 DECLERCCK
- 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.


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.

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

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.

Representative References

Patents


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 manufattura lucchese lane e fibre (Italy)

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

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- http://www.sophied.net
- http://www.quorumsensing.eu
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 lead 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


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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www.lowinputbreeds.org
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

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 RD Congo (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 ($CO_2$) and methane ($CH_4$), 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
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
Picooplankton
Small eukaryotes

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

SENIOR SCIENTISTS:
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- 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 (B-BLOOMS) SPSD 2, Research project EV/13/34B. Final report (2003-2005) Bruxelles: Science Policy Office, Belgium. 77 p. 2008.

Representative References

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)
AQUAPOLE, 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:**

Denis DOCHAIN

**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»),
- TELEMAC («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**

Funding

- European Commission
- Private companies

Partnership

- INRA
- Laboratoire d’Analyse des Systèmes et de Biométrie, Montpellier (Dr. A. Rapsport)
- 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

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 and F. Devillez. New orientations of forest management planning from an historical perspective of the relations between man and nature. Forest Policy and Economics, 7: 85-95, 2005.
- C. Farcy, C. Delhoume, G. Revelle. Social role of the forest and reception of the public. Which contribution of private forest owners? Joint final conference of forest recreation and tourism (COST E33) and 11th European Forum on Urban Forestry (EFUF), Hämeenlinna (Finland), 28-31 may 2008.

Funding

Service Public de Wallonie (DGARNE)
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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- Quentin PONETTE
- 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


Funding

- Service Public de Wallonie (DGARNE)
- 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

SENIOR SCIENTIST: Vincent HALLET

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


Funding

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

Partnership

- ULg – Département GEOMAC – Faculté des Sciences appliquées
- FPMS – Cellule d’hydrogéologie – Faculté des 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. Degre – 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 Manila University – Environmental Science for Social Change
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

KEY WORDS

Geology
Hydrogeology
Tracer test
Electrical tomography
Groundwater
Karst
GIS groundwater mapping

WEB SITE

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

Representative References


KEY WORDS
 Programming
 Covering models
 Nature reserve selection
 Spatial analysis

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Ecology of interactions and biological control

SENIOR SCIENTIST:

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- Audrey AYRINAC
- Hervé COUINET
- 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


Patents


Awards


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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**WEB SITE**

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


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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SITE WEB

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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


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

http://www.uclouvain.be/53484.html
Water and nutrient fluxes through soil, and plants

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


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

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WEB SITE
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Forest ecosystem functioning and sylviculture

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 sylvicultural 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 understory light measurement methods are developed. A special emphasis is also given to devise sylvicultural prescriptions integrating ecological, technical and economical aspects.

Representative References

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 écophysiologie; 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 subsurface 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 subsurface 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**


**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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Mathieu JAVAUX
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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


Main Equipment

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

KEY WORDS
- Pollution
- Lasers
- Gases
- Atmospheric clusters

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

WEB SITE
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 economic 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


**Funding**

- FNRS and Marie Curie IEF research grants
- *Fonds Spécial de la Recherche* (FSR) from UCL
- *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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**WEB SITE**  
Diversity, ecology, evolution and conservation of European and Mediterranean Orchids

SENIOR SCIENTIST:
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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 dramatic 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


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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WEB SITE

Integrated soil and water resources management

**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**


**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


Funding

› UCL
› FRFC
› FRIA
› Région Wallonne
› European Science Foundation (ESF)
Partnership

- Prof. C. Wieland 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

SENIOR SCIENTIST

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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

Funding
› UCL
› FSR
› FNRS
Partnership

- Rose Declerck-Floate, Weed Biocontrol, Agriculture & Agri-Food Canada, Research Centre Lethbridge, Alberta, Canada
- Claire Perilleux, 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

SENIOR SCIENTIST

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WEB SITE

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

Funding
- Minister of Foreign Affairs of Belgium, Walloon Region, WBI (Wallonie-Bruxelles International), CBR-Heidelbergcement (private company),
- DIMENC (Direction de l’Industrie, des Mines et de l’Environnement de Nouvelle-Caledonie),
- BRGM-France (Bureau de Recherche en Géologie Minière),
- Valbois RN, SAUCEL (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.
- Valbois RN: Valorisation of kaolin deposits in the Ardenne area of Belgium.
- CSTC (Centre Scientifique et Technique de la Construction), SA Ecoterres, SAUCCEL (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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WEB SITE

http://www.fundp.ac.be/universite/personnes/page_view/01006590/
Physical climatology

**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**

Main awards

- A. BERGER – European Latsis Prize 2001 of the European Science Foundation.
- 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.

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.
- Laboratoire de Glaciologie et de Géophysique de l’Environnement, Grenoble.
- University of Bristol, Bristol.
- 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
- Palaeoclimates
- Greenhouse effect
- Climate variability
- Polar regions
- Atmosphere
- Ocean
- Sea ice
- Climate impacts

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WEB SITES

http://www.uclouvain.be/astr
www.climate.be
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.

Representative References

Novel Ecological processes

SENIOR SCIENTIST:

Istvan MARKO

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 botanochemistry. 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 Calycullins), antitumor compounds (Spongistatins, Manzamin A), antifungals (Ambruticin, Milbemycin β3, 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


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: PIIXD2 WO 2006093719 A1 20060908 CAN 145.314972 AN 2006:916385 CAPLUS.


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

SENIOR SCIENTIST

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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 relevance 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


Funding

Federal Science Policy
Federal and regional public authorities

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

WEB SITES

www.cedre.be
www.fusl.ac.be/cedre
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

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-atmospheres 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

Funding
- EU
- Communauté française de Belgique
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


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

SENIOR SCIENTIST

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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


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 Polytech- nique 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 research explicitly focuses on the analysis of daily travel and mobility of individuals, using aggregate and disaggregate models. The main active developments are focused 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.

Representative References


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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Philippe TOINT
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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

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)
- Conference Permanente du Development 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

SENIOR SCIENTISTS

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- www.urba.ucl.ac.be
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

**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

**KEY WORDS**

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

**SENIOR SCIENTIST**

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**WEB SITE**

www.ecochange-project.eu

**Products and Services**

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


Awards

**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:**
- Michel HUBERT

### Research Field and Subjects


### Representative References

- M. Hubert, F. Dobruzske, 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

### SENIOR SCIENTIST

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- [www.jobmob-and-famlives.eu](http://www.jobmob-and-famlives.eu)
- [www.fusl.ac.be/ces](http://www.fusl.ac.be/ces)
- [www.irib.be](http://www.irib.be)
Sustainable Mobility and Network Planning

**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**


**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, ergonomy, 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.

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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Funding

“First spin off”, DG 06, Région wallonne

Partnership

- EO-EDPS (Lyon)
Participatory Cartography and Land Planning

SENIOR SCIENTIST:
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

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 Landfil 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

SENIOR SCIENTIST

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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
- C. BEAUCHEMIN and B. SCHOUMAKER, Migration to cities in Burkina Faso. Does the level of development in sending areas matter?, World Development, 33, 7, 1129-1152, 2005.

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


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:
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- 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


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


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:
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- 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 constrain operate both on the demand and supply sides of the innovation market, because the innovation suppliers are also wealth-constrained.

Representative References

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.

KEY WORDS
- Innovation
- Adoption
- Herding
- Food security
- Poverty

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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


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:
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- 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.

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

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.

Representative References

Emerging high-throughput approaches to analyze bioremediation of sites contaminated with hazardous and/or recalcitrant wastes, Biotechnol. Advances, 26, 2008, p. 561-575.


**Patents**


**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

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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


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


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

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


Funding

- SPP PS
- EEA
- FNRS

Partnership

- K. Gram-Hanssen, Danish Building Research Institute and Aalborg University, Denmark
- M. de Best – Waldhofer, 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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- Yann BARTOSIEWICZ
- 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.

Representative References

**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 transfert 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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- Denis FLANDRE
- 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
- G. Gosset, B. Rue and D. Flandre. Very high efficiency 13.56 MHz RFID input stage voltage multipliers based on ultra-low power MOS diodes. IEEE Int. Conf. RFID, 134-140, 2008.

Patents
- Ultra-low power basic blocks and their uses, PCT/EP01/15023, European patent, 17/12/2001, V. Dessard, S. Adriaensen and D. Flandre.

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 \textit{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


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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www.etsf.eu
www.abinit.org
www.cism.ucl.ac.be/Equipements/Machines
www.pcpm.ucl.ac.be/themes/MBPT.php
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

- Architecture et Climat, Energie, version 6, Conception énergétique des bâtiments tertiaires, Ministère de la Région Wallonne, 2009.

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 (TRNSYS, 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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- 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. TiO₂ 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 TiO₂ 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/thermochromic 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
- FTIR, 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


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

SENIOR SCIENTISTS:
- Eric Gaigneaux
- Patricio Ruiz

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: C₂ (CH₂) to C₆,
  - sulfur containing compounds (thiols)
  - nitrogen containing compounds (amines),
  - ozone;
- the elimination of NOx and SOx 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

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 6 l/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

SENIOR SCIENTIST:

Ernest MATAGNE

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


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
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

› 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

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- 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


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 nanostructuration 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 monocristalline 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

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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.

Patents
Catalytic CO₂ Methanation process; Patent deposed on July 07, 2008; MARC JACQUEMIN, NATHALIE BLANGENOS, 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


Funding

- AIE-DGTER
- 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, NOx, 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:

 › Alfred BERNARD

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


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:**
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**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**


**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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- 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

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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Nanotoxico: Effect of manufactured nanoparticles on human health

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- 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.

“Nanotoxico” 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 Nanotoxico 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


Patents

- Lucas S. Radioactive device 2006, WO2006063418, WW
Funding

This platform is supported by SPW (Nanotoxico RW/FUNDP) research convention n°516252.

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 (Altaïs) for nuclear reactions based spectroscopy.
Field Emission Gun - Scanning Electron Microsocpe 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 Induces 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:

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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


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

KEY WORDS

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

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Impact of poverty on environmental degradation in the Indian Himalayas

SENIOR SCIENTIST:
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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 know 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


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

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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


Partnership

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


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)
- Jahanwal 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


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).

Representative References

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**


**Funding**


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://www.info.ucl.ac.be/~sgm/ambience.html
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

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


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.

Representative References


KEY WORDS

Innovation
Corporate Responsibility
High-tech companies

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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, L’intérêt social comme vecteur de la responsabilité sociétale, Louvain-la-Neuve, Academia-Bruylant, 2008.
- J. Malherbe, Y. De Cordt, Ph. Lambrecht & Ph. Malherbe, Précis de droit des sociétés, 3ème édition, Bruxelles, Bruylant, 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


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


Funding

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

Partnership

› Université de Montréal
› UQAM
› Université Autonome Métropolitaine
› Mexico
› Pontifícia 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”.

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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.

Representative References


Awards

Dopp Prize 2001

Funding

ARC Sustainability Project

KEY WORDS
Political Philosophy
Ethics
Public Policy
Sustainability

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Environmental, Rural and Urban Planning Law for a Sustainable Development

SENIOR SCIENTISTS:
- Francis HAUMONT (SERES)
- 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 axes:

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

- D. JANS, Droit de l’environnement et nuisances industrielles, Bruges, La Charte, 450 p, 2006.

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

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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’s 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.g. 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.

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

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


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

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


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 intriguces representation’s legitimacy and efficacy.

Representative References


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

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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.

Representative References


KEY WORDS

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

SENIOR SCIENTIST

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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.

Representative References

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 demography 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.

Representative References


**Funding**

Public funding (F.R.S.-FNRS, UCL-FSR)

**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
- Ecological modelling
- Experimental ecology
- Lepidoptera
- Microcosms
- Population viability analysis
- Metapopulation
- Dispersal
- Habitat quality

**SENIOR SCIENTIST**

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