# Master 2 Ecology and Sustainable Development

## Environmental Management and Sustainable Development (EMSD)

## 2024 - 2025

UNIVERSITÉ CATHOLIQUE DE L'OUEST

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France

Program director:

Oihana LATCHERE (olatcher@uco.fr)

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# Course Unit Summary

(Click on the title to follow the link towards teaching unity description)

| Teaching Unity | Credits | Duration | CM | TD | TP |
|---|---|---|---|---|---|
| 3UE14 – Environmental and urban law | 5 | **45h** | 28h | 17h | |
| 3UE15 – Policy and economy of sustainable development | 3 | **30h** | 18h | 12h | |
| 3UE16 – Geographic Information System | 3 | **30h** | 15h | | 15h |
| 3UE17 – Project management and ethics | 2 | **27h** | 17h | 10h | |
| 3UE18 – Management of environmental risk | 5 | **45h** | 20h | 15h | 10h |
| 3UE19 – Industrial and territorial management | 5 | **45h** | 10h | 35h | |
| 3UE20 – Environmental management | 3 | **30h** | 12h | 12h | 6h |
| 3UE21 – English | 2 | **24h** | | 24h | |
| 1 UE pour FI/CA : | | | | | |
| 3UE12 - CA – Experimental project | 2 | **24h** | | 12h | 12h |
| 3UE13 – FI – Project in workplace | 2 | **24h** | | 24h | |

## Master's degree Biodiversity, Ecology, Evolution

## Course Ecology and sustainable development

# 3UE14 – Environmental and urban law

### General objectives

The primary aim of environmental law is to protect the environment and to establish a legal framework for the sustainable use of natural resources. It encompasses regulations governing pollution control, forest conservation, mineral extraction, and the management of natural resources and wildlife populations.
Environmental law addresses a broad spectrum of issues, including air and water quality, the remediation of contaminated sites, waste management, chemical safety, and the protection of both animal and plant species.

**Environmental law**: Right, Water, Air, Habitats, Landscapes, ICPE, Climate change

Urban law encompasses the body of laws, policies, decisions, and practices that govern the planning, management, and development of urban environments. Its primary objective is to promote reform and address the pressing challenges faced by cities and urban systems.

**Urban planning law**: Right, National urban planning guidelines, territorial planning guidelines

| Skills bloc | ECTS credits |
|---|---|
| Scientific skills | Final exam (3 ECTS) / Continuous assessment (2ECTS) |

### Targeted skills

To analyze environmental law and its practical applications ; to understand the legal system, relevant norms, and legal vocabulary related to environmental and urban issues ; to interpret and assess current regulations in order to provide informed advice to project stakeholders in the fields of environment, spatial planning, and urban development ; to address the complex challenges of urban development while integrating the principles of sustainable development.

### Speakers

Philippe FOTSO pfotso.kamdem@gmail.com

PhD in Marine Environmental Law

Environmental lawyer

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Delia QUILLA TIPULA delia.qt@gmail.com

Legal expert in environmental law

## Part 1 : Environmental Law Foundations and Tools: Structural Overview and Specialized Protection Measures (P. FOTSO)
## 18h of lectures and 15h of tutorials

Part I: Structural Overview of Environmental Law (EL)
Revisiting fundamental legal knowledge - Sources of law, the pyramid of norms, how to read a court decision (e.g.: The Erika Case)
1. Definitions
2. Main characteristics of environmental law
3. Historical and theoretical foundations of environmental law
4. Sources of Environmental Law

Part II: Special environment law
Focus on nature conservation tools: protected natural areas - The terrestrial environment - The marine environment - cross-cutting protection tools: green and blue grids

A. Preservation of biodiversity and natural areas
B. Fight against climate change outline presentation
C. Prevention of natural and technological risks
D. Fight against pollution and noise pollution

**Type of continuous assessment** Multiple-choice questionnaire

## Part 2 : Environmental Law and Urban Planning: Principles, Instruments, and Integration for Sustainable Development (D. QUILLA TIPULA)
## 10h of lectures and 2h of tutorials

**Evolution and Characteristics of Environmental Law**
Chronology: from ancient roots to the 1960s, rise in the 1990s, key milestones (Stockholm 1972, Rio 1992, Kyoto 1997)
Defining features: interdisciplinarity, lack of watertight borders, maturity phases
Distinctive traits compared to other legal branches

**Sources of International, European and French Environmental Law**
International treaties and soft law: Stockholm Declaration, Rio Declaration, Johannesburg, Aarhus Convention
EU level: Maastricht, Amsterdam, Water Framework Directive
French national law: Environmental Charter (2005), Environmental Code (2000 “à droit constant”)
Judicial sources: Constitutional Council, Conseil d’État jurisprudence

**Core Environmental Principles**
Prevention vs. Precaution: definitions, application conditions, examples
Polluter-pays principle: scope and case illustrations
Sustainable development (Brundtland Report 1987)
Information & participation (Aarhus Convention)
Non-regression principle

**Regulatory Instruments and Enforcement Mechanisms**

Environmental Impact Assessments, eco-audits and ISO certifications
Zoning instruments: PPRI, SCOT, SDAGE, Agenda 21, PCAET

Police powers in environmental matters: State, regions, departments, municipalities
Public enquiry, authorizations and enforceable public-utility easements

**Environmental Law Meets Urban Planning**
Integrating environmental components into the PLU
Building permits and enforceable adaptation documents (PCAET, PPRI)
Environmental obligations in inter-municipal planning (EPCI duties)
Overview of the 2016 Biodiversity Law and new principles

## Advised references

Décret n° 2016-1071 du 3 août 2016 relatif au schéma régional d'aménagement, de développement durable et d'égalité des territoires
Marcus, G., Siri, J., Gatzweiler, F., Dora, C., Aerts, J., Nandudu, S., ... & de Sá, T. H. (2022). Supporting a Healthy Planet, Healthy People and Health Equity through Urban and Territorial Planning. Planning Practice & Research, 37(1), 111-130.

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# 3UE15 – Policy and economy of sustainable development

### General objectives

Sustainable development encompasses four interconnected dimensions: society, environment, culture, and economy. Achieving sustainable growth requires a balanced management of the relationship between humans and their environment. The overarching goal is to preserve natural resources while ensuring equitable access to healthy food, energy, water, and medicine for all. To this end, both international and national economic systems must foster economic growth while addressing global environmental challenges.

In this course, students will explore the history and evolution of sustainable development, with a particular focus on its economic dimension. They will examine how this concept is implemented by corporations and across national territories, through case studies on environmental monetary valuation, responsible tourism, certification schemes, and low-carbon strategies.

| Skills bloc | ECTS credits |
|---|---|
| Scientific skills | Final exam (3 ECTS) / Continuous assessmant (1ECTS) |

### Targeted skills

Apply project management principles and scientific analysis tools to support effective environmental management ; Design sustainable environmental policies by integrating biological, social, and managerial components ; Understand the monetary valuation of the environment through appropriate methodological approaches ; Analyze the use of economic and regulatory instruments in environmental management.

### Speakers

Carmen CANTUARIAS c.cantuarias@groupe-espi.fr

*Environmental economist – Teacher/researcher ESPI2R/GREThA*

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Emmanuelle LAFOND emmanuelle.lafond@yahoo.fr

*Lecturer in Sustainable Development*

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Mathilde MILOT mathilde.milot@advenirse.fr

*Trainer & Consultant in CSR / CSRD*

Founder of 'AdveniRse'

## Part 1 : Natural capital Valuation and non-renewable resources (C. CANTURIAS)
## 6h of lectures and 4h of tutorials

**History of environmental incentives**

- The economic approach of incentives.
- Natural capital in the economy system.

**Valuation of environmental goods**

- Principles of valuation: option value, request value, existence value.
- Valuation methods: indirect methods, direct methods (contingent valuation), principles of cost-benefit analysis (CBA).

**Environmental regulation**

- Environmental policy instruments: the optimum of pollution, private internalization solutions, implementation problems, choice of instruments.
- Strategies for implementing environmental policies: the role of taxes/ecotaxes, standards, tradable emission allowances, strategies adopted by polluters.

**Type of continuous assessment** Oral presentation

## Part 2 : Sustainable Development in corporate and tourism (E. LAFOND)
## 6h of lectures and 4h of tutorials

Sustainable development (definition, objectives, threats, historical background)
Multilateral agreements
From Millenium Development Goals (MDGs) to Sustainable Development Goals (SDGs)
Corporate Society Responsability (CSR)
Responsible tourism
Certifications & Labels
Study case : Sustainable tourism
Videos and article studies about COP26 and environmental policies.

**Type of continuous assessment** Sulitest
Testimonials (Energy Efficiency in the Industrial Sector – Job position EY Consultant & Auditor in Sustainable development)

## Part 3 : Sustainable Development in corporate and tourism (M. MILOT)
## 6h of lectures and 4h of tutorials

**The European Green Deal: Strategy and Business Impacts**
Origins and timeline: from 2014 NFRD to 2021 Climate Law
Six Green Deal objectives: climate, circular economy, biodiversity, pollution, energy, mobility
“Farm-to-Fork” and Industrial Plan case studies
Group debate: Opportunity vs. challenge for businesses

**CSRD and ESRS: Transparency in Sustainability Reporting**
Evolution from NFRD to CSRD: scope, audit requirements, standardized framework

Introduction to ESRS: cross-cutting, environmental, social, governance standards
Reporting obligations and phased timelines by company size
Value-chain disclosures (Scope 1–3 emissions)

**Double Materiality and Extra-Financial Reporting**
Concept and seven-step double materiality assessment
Financial vs. environmental & social materiality
Practical exercise: mapping Telefónica's materiality matrix
Case study: analyzing Kering's 2022 extra-financial report

**EU Taxonomy: Classification and KPIs**
Purpose and six environmental objectives of the Taxonomy
"DNSH" and "Minimum Safeguards" criteria
Eligibility vs. alignment: CapEx, OpEx, turnover KPIs
Examples of enabling, adapted, and non-eligible activities

**Corporate Sustainability Due Diligence (CSDD)**
Scope and timeline: EU vs. French law on corporate vigilance
Key obligations: risk identification, prevention, remediation, grievance mechanisms
Liability and penalties for non-compliance
Case study: reflections on Bhopal Gas Tragedy and modern supply chains

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# 3UE16 – Geographic Information System

### General objectives

Geomatics, also referred to as geospatial science (including geomatics engineering, geospatial engineering, and geospatial technologies), is the discipline concerned with the collection, storage, processing, analysis, and dissemination of geographic or spatially referenced information. It encompasses a broad range of data, software products, services, and specialized tools used for the integration and management of geographic data.

Geographic Information Systems (GIS) are defined by National Geographic as "a set of tools for the input, storage and retrieval, manipulation and analysis, and output of spatial data." From a problem-solving perspective, GIS can be understood as:

a) a specialized digital database in which a common spatial coordinate system serves as the primary means of storing and accessing data;

b) an interoperable technology;

c) a decision support system that integrates spatially referenced data within a problem-solving environment.

This course adopts a practical, case-based approach to introduce students to the fundamental types of geographic data, key concepts, tools, and applications of GIS in the context of environmental analysis and management.

| Skill bloc | ECTS credits |
|---|---|
| Digital tools | Continuous assessmant (3ECTS) |

### Targeted skills

Identify and describe key applications of GIS in the modeling, analysis, and management of environmental challenges ; Analyze the role of GIS as a decision-support tool within its fields of application.

### Speaker

Carlos SALGUERO carlos.salguero@iclaves.fr

*GIS consultant*

Founder of 'ICLAVES'

## Geographic Information System (C. Salguero)
## 15h of lectures and 15h of practical classes

- GIS Overview
- Spatial Data Integration
- Spatial Data Representation
- Data editing
- Spatial Analysis
- Remote Sensing
- Spatial Decision Analysis and Modelling
- GIS for Environmental applications: study cases

Approach

- Lectures
- Videos
- Use of QGIS to represent geographic data and to implement analysis tools related to selected study cases

| | |
|---|---|
| **Type of continuous assessment** | Group assignments<br>Internet and bibliographic research and presentation of GIS projects implementations and / or research studies on environmental issues.<br>Study cases using QGIS |

Advised references

GIS for Environmental Applications, Zhu, Xuan, 2016, Routledge,Taylor and Francis (available in the UCO's library of the Angers campus)

Optional additional references:

GIS, Environmental Modelling and Engineering, Allan Brimicombe, 2010, Taylor & Francis Group

GIS and Environmental Monitoring, Applications in the Marine, Atmospheric and Geomagnetic Fields, Stavros Kolios ans alt., Springer, 2017

Geoinformatics and Modelling of Landslide Susceptibility and Risk, An RS & GIS-based model building approach in the eastern Himalaya, Sujit Mandal & Subrata Mondal, Springer, 2019

Environmental Modelling with GIS and Remote Sensing, Andrew Skidmore, Taylor & Francis, 2002

GIS for Environmental Decision-Making, Andrew Lovett & Katy Appleton, Taylor & Francis, 2008

GIS for Environmental Applications, A practical approach, Xuan Zhu, Routledge, 2016

Environmental Remote Sensing and GIS in Iraq, Ayad M Fadhil Al-Quraishi & Abdelazim M. Negm, Springer, 2019

ArcGIS for Environmental and Water Issues, William Bajjali, Springer, 2018

Spatial Modeling in GIS and R for Earth and Environmental Sciences, Hamid Reza Pourghasemin Candan Gokceoglu, Elsevier, 2019

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# 3UE17 – Project management and ethics

### General objectives

Environmental project management requires not only technical expertise but also strong interpersonal skills to engage effectively with stakeholders and support ethical decision-making processes.

In this course, students will explore the foundations of project management, including its definitions, diversity, and key challenges. Effective leadership in environmental projects involves managing people-building, motivating, and coordinating a project team; through self-awareness, active listening, and conflict resolution.

From a communication standpoint, project leaders must also steer and monitor progress using appropriate collaborative tools. Additionally, they will be expected to evaluate the environmental and financial implications of a project, particularly the cost–environment benefit ratio.

The objective of this course is to develop an understanding of ethical decision-making and to learn how to integrate environmental considerations across all levels of the decision-making process.

| Skill bloc | ECTS credits |
|---|---|
| Professional skills | Continuous assessmant (2ECTS) |

### Targeted skills

Communicate and negotiate effectively with stakeholders in the environmental sector ; establish and maintain professional relationships to foster collaboration and trust ; select and employ appropriate tools, channels, and techniques for interactive communication ; Plan, coordinate, and oversee all phases of an environmental project ; Lead project teams, anticipate and evaluate key challenges, and ensure objectives are met ; Facilitate meetings to drive consensus and productive dialogue ; Apply ethical decision-making frameworks to guide project choices and trade-offs.

### Speakers

Nicole LAFRASSE-VAN DEN ASSEM info@emerod.com

*Consultant in Transformation and Growth*

Founder of 'Une émeraude en Anjou'

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Alexandre TRIKI atrikipro@gmail.com

*ESG Manager*

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Claire LARROQUE larroque.claire@gmail.com

*PhD in Philosophy, Lecturer and Trainer*

## Part 1 : Leadership development (N. LAFRASSE)
## 5h of lectures and 3h of tutorials

The various links and decision organs of a structure (company, association...) with the angle of an ecosystem:
Roles and rules in management
Mission, values
Stakeholder, governance
HR
Finance (budgets, costs and revenus)
Marketing/sales
Supply chain
Team management (understand and guide, Body language,..)
Environmental impacts
Social impacts
Societal impacts
Essential student competencies: crafting an effective CV and cover letter, and mastering both verbal and nonverbal communication skills.

**Type of continuous assessment**

Each student will be assessed on a topic of their choice and must:

1. Deliver a concise summary of their understanding of the lecture (5 minutes).
2. Present the topic with a concrete example (5 minutes) and propose solutions to address the problem (15 minutes).
3. Pitch themselves—using their CV and cover letter—to explain why the company should hire them (time as allocated).

## Part 2 : Ethics, Rhetoric, and Environmental Advocacy (A. TRIKI)
## 6h of lecture and 5h of tutorials

**Introduction: Why Rhetoric Matters for Environmental Advocacy**
Examine why facts alone don't persuade; review key social perceptions of climate change.

**Core Concepts: Rhetoric, Dialectic, and Ethics**
Define rhetoric vs. dialectic; explore the relationship between rhetoric and ethics.

**Choosing Your Arguments: Rigor vs. Effectiveness**
Distinguish rigorous (logically sound) from effective (highly persuasive) arguments; survey different argument types (e.g. framing, authority, analogy).

**Building a Coherent Argumentative Line**
Inventory and evaluate available arguments; sequence arguments to balance rigor, effectiveness, and subjectivity.

**Counter-arguing and Objections**
Practice ad rem, ad hominem, and ad personam objections; develop strategies for pre-empting counter-arguments.

**Handling "Uncomfortable" Facts**
Learn denial, reinterpretation, and relativization tactics; discuss ethical considerations when confronting inconvenient evidence.

**Structuring Your Thinking and Presentation**
Frame your core idea ("red thread"); apply Cicero's four-part speech structure: exordium, narration, argumentation, peroration.

**Closing & Next Steps**
Recap key take-aways; assign follow-up reading and/or case study preparation.

**Type of continuous assessment** Oral presentation

## Part 3 : Project Management & Environmental Ethics (C. LARROQUE)
## 6h of lectures and 2h of tutorials

**Foundations of Ethics & Environmental Ethics**
Definitions: philosophy, ethics, morality
Normative schools: consequentialism (utilitarianism) vs deontology (Kantianism)
Moral dilemmas and reasoning (e.g., trolley problem, cross-species transplant)
Instrumental vs intrinsic value; moral considerability
Ethical perspectives: anthropocentrism, zoocentrism, biocentrism, ecocentrism

**Environmental Ethics in the Climate Change Context**
Scientific overview: global warming, greenhouse effect, Anthropocene
Impacts on humans, wildlife, ecosystems
Sources of disagreement: uncertainty, values, cost-benefit limits
Ethical challenges: mitigation vs adaptation, global justice, historical responsibility
Duties to future generations; the "argument from ignorance"

**Wicked Problems & Environmental Controversies**
Characteristics of wicked problems (Rittel & Webber 1973)
Role of values, uncertainty, plural knowledge systems
Case study: Florida Everglades restoration (CERP)
Intervention ecology vs restoration ecology
Strategies for adaptive, participatory management

**Ecological Restoration & Philosophical Critiques**
Definitions and history of ecological restoration (SER 2002)
Debates over history and authenticity: "pristine nature" and "faking nature" (Elliot, Katz)
Restoration as partnership vs domination (Light, Higgs)
Ethical questions: ends, methods, reminders of past damage
Adaptive management cycle for experimental ethics

**Project Management Implications & Ethical Integration**
Recognizing variation in problem definitions and stakeholder values
Communicating scientific uncertainty and building trust
Designing ethically robust restoration or development projects
Tools: ethical impact assessment, stakeholder engagement, grievance mechanisms
Preparation for student-led presentations

**Type of continuous assessment :** Students will collaborate to investigate an environmental controversy by selecting a case, conducting a press and literature review, and charting its temporal evolution through key actors, arguments, uncertainties, and public arenas. They will then produce a report that preserves the debate's complexity and power relations, featuring graphical tools such as timelines, debate trees, and arena maps. This exercise hones critical analysis of socio-technical controversies and group research skills in a remote tutorial setting.

## Advised references


Brown University, "A Framework for Making Ethical Decisions"

https://www.brown.edu/academics/science-and-technology-studies/framework-making-ethical-decisions

Santa Clara University, "A Framework for Ethical Decision Making"

https://www.scu.edu/ethics/ethics-resources/a-framework-for-ethical-decision-making/

## Master's degree Biodiversity, Ecology, Evolution

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# 3UE18 – Management of environmental risk

### General objectives

The management of environmental risk includes a multidisciplinary approach to describe potential hazards and impacts on the environment, to evaluate the risk of occurance and to identify precautions to reduce the risks. Student will work on a project to determine microplastic composition, colours and shape in samples from Loire.

| Skill bloc | ECTS credits |
|---|---|
| Scientific skills | Final exam (3 ECTS) / Continuous assessmant (2CTS) |

### Targeted skills

Analyze environmental risks and formulate corresponding mitigation scenarios, including ecosystem preservation, remediation, and restoration ; Apply the instruments and methodologies required for comprehensive environmental risk assessment ; Attain familiarity with international regulatory frameworks governing environmental risk management.

### Speaker

Barbara RETHORE barbare.rethore@uco.fr / contact@natexplorers.fr

*Biologist – Scientist mediator*

Founder of 'Natexplorers'

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Amélie CHATEL achatel@uco.fr

*Course Manager « Ecology and sustainable development UCO master »*

*Professor at UCO, laboratory BIOSSE (Organisms Biology, Stress, Health, Environment)*

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Oihana LATCHERE olatcher@uco.fr

*Course Manager « Environmental Management and Sustainable Development » (M2 Ecology and sustainable development UCO)*

*Associate professor, laboratory BIOSSE 'Organisms Biology, Stress, Health, Environment)*

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Andrew BARRICK andrew.barrick@auburn.edu

Postdoctoral Research Fellow, ecotoxicologist

Aubrun University, USA.

## Part 1 : The Biodiversity Crisis: Context, Drivers and Conservation Responses (B. RETHORE)
## 7h of lectures, 7h of tutorials and 4h of practical classes

**Planetary Boundaries and the State of the Living World**
Introduction to the nine planetary boundaries and their current transgression
Biodiversity as a core boundary—safe operating space vs. high–risk zone
Key metrics: biocapacity, ecological footprint, Living Planet Index

**Framing Biodiversity in Global Policy**
Definitions of biodiversity (from genes to ecosystems)
Convention on Biological Diversity (CBD), Aichi Targets and Post-2020 Framework
Alignment with Sustainable Development Goals and the UN Decade on Ecosystem Restoration

**Measuring Biodiversity Loss**
Species extinction rates: background vs. current
IUCN Red List categories and regional/national assessments
Introduction to the IUCN Green Status of Species and avoided extinctions

**Drivers of Biodiversity Decline**
Land- and sea-use change: deforestation, wetland drainage, habitat fragmentation
Overexploitation: subsistence hunting, fisheries bycatch, wildlife trade
Climate change: scenarios, vulnerability and range shifts
Pollution and novel entities: agrochemicals, plastics, heavy metals
Invasive alien species and emerging diseases

**Conserving and Restoring Biodiversity**
Ecosystem services: supporting, provisioning, regulating and cultural
Conservation success stories and challenges (e.g., California condor, Everglades restoration)
Adaptive management and intervention ecology
Strategies for reconnecting protected areas and mainstreaming biodiversity

**Type of continuous assessment** Poster and debate

## Part 2 : Environmental Risk Assessment: Integrating Chemical Monitoring and Biomonitoring (A. CHATEL)
## 4h of lectures, 3h of tutorials

**Foundations of Environmental Monitoring**

Risk management cycle: Identify → Analyze → Control → Monitor → Act

Media selection: soil, sediments, surface & deep waters, air

Overview of chemical vs. biological approaches and their roles in ERC (Avoid, Reduce, Compensate)

**Chemical Monitoring Techniques**

Analytical workflows: sampling, extraction, chromatography, mass spectrometry

Interpreting chromatograms and concentration data

Strengths, detection thresholds, matrix interferences, and limitations

**Principles of Biomonitoring & Bioindicator Selection**

Levels of biological organization: molecular, cellular, organism, population, community, ecosystem

Criteria for bioindicator choice: sensitivity, specificity, ecological relevance

Early-warning markers vs. long-term endpoints

**Biomarkers of Exposure and Effect**

Molecular biomarkers: DNA adducts, biotransformation enzymes, AOP framework

Oxidative stress enzymes (CAT, SOD, GPX, GR), lipid peroxidation (MDA, TBARS)

Stress proteins and lysosomal stability; immune responses and neurotoxicity assays

**Integrating Biomarkers into Risk Assessment**

Organismal-level endpoints: growth, reproduction, scope for growth, cellular energy allocation

Population/community responses: shifts in species composition, functional indices

Case studies linking chemical loads in sediments/fish to biomarker responses in Gadus morhua and benthic invertebrates

## Part 3 : Chemical Contaminants and Environmental Risk Assessment (O. LATCHERE)
## 4h of lectures, 3h of tutorials

**Principles of Environmental Risk Management**
Environmental risk management cycle: identification, analysis, control, monitoring, action
Qualitative vs. quantitative risk characterization (PEC/PNEC, risk ratio)
Grading and matrix-based approaches to probability and severity
Stakeholder engagement and the role of socio-economic, legal, and ethical factors

**Chemical Monitoring in Terrestrial Ecosystems**
Importance of soils: habitat and retention functions
Sources and fate of trace metals in agricultural soils (Cd, Pb, Zn, Cu)
Sampling design: depth, spatial heterogeneity, matrix components
Plant and invertebrate bioindicators (Lemna, Arabidopsis, Helix) and biomarker responses

**Chemical and Biological Assessment in Aquatic Compartments**
Pathways of industrial discharges and accidental vs. chronic pollution
Analytical methods for water, sediment, fish (PCBs, pesticides, heavy metals)
Embryolarval toxicity tests in oysters and genotoxicity assays
Integration of chemical concentrations with biological endpoints

**Emerging Contaminants, Micro- and Nanoplastics & Regulatory Responses**
Sources, types, shapes, and environmental fate of micro-/nanoplastics
Exposure pathways and effects on algae, bivalves, fish, and human health
Frameworks for microplastic risk assessment (exposure, fate, effects, AOP)
Overview of French AGEC law and international regulations targeting single-use plastics

**Type of continuous assessment:** Poster

## Part 4 : Global Ecotoxicology and Environmental Risk Assessment (A. BARRICK)

### 5h of lectures

**Foundations of Ecotoxicology & Risk Assessment**

Definitions: ecotoxicology vs. environmental toxicology

Risk-assessment framework: hazard identification, exposure, dose–response, risk characterization, management

Weight-of-evidence and lines of evidence (molecular→community)

Case study: Port 2000 development in the Seine Estuary

**Monitoring Chemical Pollutants in Soil and Water**

Terrestrial compartment: sampling design, depth profiles, trace-metal fate and bioavailability

Aquatic compartment: pesticide, PCB, heavy-metal analysis in water, sediments, fish

Analytical techniques: chromatography, mass spectrometry, detection limits

Linking concentration data to ecological impact

**Biomonitoring & Biomarkers Across Biological Organization**

Bioindicator selection: molecular, cellular, individual, population, community, ecosystem levels

Biomarkers of exposure vs. effect; early-warning markers

Adverse Outcome Pathway (AOP) approach

Integrative case studies: mussel enzymatic biomarkers, fish genotoxicity assays

**Ecotoxicology of Micro- and Nanoplastics**

Sources, shapes, sizes, and environmental fate of MPs/NPs

Exposure pathways and trophic transfer (Mountain-to-Sea, TROPHIPLAST project)

Tiered ERA for plastics: particle characterization → exposure → effects → AOP

Regulatory responses (French AGEC law, California plastics strategy)

**Nanomaterials in the Environment & Safe-by-Design**

Nanomaterial definitions, unique properties, and applications

Hazard and risk assessment challenges: grouping, read-across, data gaps

NanoReg2 framework: FAIR data, benchmark materials, high-throughput screening

Safe(r)-by-design strategies and case studies (carbon nanofibers, silicon composites)

## Master's degree Biodiversity, Ecology, Evolution

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# 3UE19 – Industrial and territorial management

### General objectives

In this course, we examine the sustainable city as an urban system that integrates ecological principles and sustainable development across social, economic, environmental, and cultural dimensions. Through case studies, site visits, and team projects, you will explore how urban and industrial environments can enhance citizen well-being via green building and industry practices. We'll analyze the dynamic interactions between natural resource systems and urban planning, and you'll learn to apply best practices for minimizing a building's impacts on human health and ecosystems throughout its life cycle—design, construction, operation, maintenance, and decommissioning. Finally, the course investigates energy efficiency strategies and technologies that reduce consumption and safeguard the environment.

| Skill bloc | ECTS credits |
|---|---|
| Scientific skills | Final exam (3 ECTS) / Continuous assessmant (2ECTS) |

### Targeted skills

Formulate sustainable environmental management strategies that holistically integrate ecological, social, and organizational dimensions ; Analyze the complexities and challenges of industrial and territorial governance within a sustainable development framework. ; Evaluate the pivotal role of responsible natural-resource stewardship in fostering sustainable industrial and regional growth. ; Apply industrial-ecology and strategic-management principles to advance progress toward the United Nations Sustainable Development Goals.

### Speakers

Manuel MORALES

*Professor of Innovation and Circular Economy*

Clermont School of Business

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Steffen RIES

*Sustainability Program Manager - Innovation Academy*

## Part 1 : Sustainable development in Freiburg
## 20h of tutorials

**Introduction to Freiburg's Sustainability Strategy**
Renewable-energy transition (solar, biomass)
Compact-city planning: short-distance networks
Public-transport and cycling expansion
Freiburg Climate Action Plan

**Historical and Contemporary Old Town**
Oberlinden medieval quarter
1970s Konviktstraße refurbishment
Evolution and enlargement of the pedestrian zone (2012–2019)
Tram network origins (since 1901) and parking-management policies

**New City Hall & "Kleineschholz" District**
Energy-plus design: solar-module façade and roof
840-person administration hub
Kleineschholz master plan: 500 climate-neutral homes, social inclusivity, 0.3 parking spaces/unit

**Weingarten Social-Housing Quarter**
1960s estate with 11 000 residents from 70+ nations
Community-led social and economic revitalization projects
Passive-house retrofit of 1970s slab tower
On-site neighborhood management and role-play session

**A Century of Urban Planning a. Haslach Garden-City (early 1900s)**
Terraced homes, large private gardens, self-sufficiency ethos b. Gutleutmatten New Development
500 mixed-tenure units, half subsidized rentals
Solar-thermal district heating, wood-construction pilot, Ökogeno cohousing

**Ecological Hotel Tour**
Roof-garden solar collectors, micro-wind turbines
Wood-pellet boiler, groundwater cooling, water-saving systems

**Rieselfeld Model District**
Low-energy housing and green corridors
Citizen engagement, social services, cultural activities
Integrated traffic, energy, playgrounds, rainwater management
Preview of Dietenbach: Freiburg's first climate-neutral district (6 500 units)

**Vauban Sustainable Neighbourhood**
Mobility concept: car-light, walkable streets

Renewable-energy microgrid, passive and low-energy homes
Green corridors and community gardens
“Vaubanaise” inclusive intergenerational housing cooperative

**Type of continuous assessment** Oral

## Part 2 : Industrial and Territorial Ecology for Sustainable Development (M. MORALES)
## 4h of lectures and 6h of tutorials

**Complexity & Systems Thinking in Industrial Territories**

Introduce Complex Adaptive Systems (CAS): emergence, self-organization, feedback loops

Multi-level structure of territories: micro (agents), meso (networks/symbioses), macro (policy frameworks)

Sources of complexity: multiple variables, non-linearity, interconnections

Tools for systems analysis: causal-loop diagrams, stock-and-flow models, scenario building

**Embedding Industry in Urban Ecosystems**

Defining the sustainable city: social, economic, environmental integration

Industrial Ecology (IE): nature-inspired production networks and material/metabolism analogies

Urban Metabolism (UM): mapping material and energy flows through cities

Urban Ecology (UE): human-nature interactions, ecosystem services in urban planning

**Circular Economy & Socio-Technical Transitions**

Core principles of the Circular Economy: slowing, closing, intensifying, extending loops

Multi-Level Perspective (MLP) on transitions: niches, regimes, landscape

Collective action frames & circular business models (3R, 10R frameworks)

Narratives and trade-offs: rebound effects, Jevons paradox, indicators for circularity

**Industrial Symbiosis, Policy & Systemic Tools**

Defining Industrial Symbiosis: by-product exchanges, shared utilities, co-location benefits

Case studies: Kalundborg (Denmark), Dunkerque/Lille (France), Norrköping (Sweden)

Regulatory landscape: EU Circular Economy Action Plan, Zero-Net Industry Act, REACH, Ecodesign

Systemic tools for planning & governance: sustainability diagnostics, multi-criteria matrices, participatory scenarios

Advised references

https://www.asla.org/climatepolicies.aspx

https://uwe-repository.worktribe.com/preview/1054129/Biodiversity__human_health_post_print.pdf

https://world-habitat.org/world-habitat-awards/winners-and-finalists/twelve-urban-ecology-projects-in-hedebygade/

## Master's degree Biodiversity, Ecology, Evolution

## Course Ecology and sustainable development

# 3UE20 – Environmental management

### General objectives

In the context of sustainable development, the environmental management is a big subject starting from the understanding and diagnostic of the environment to the establishment of coherent action protecting the environment or health. This course will take place in two part.

The first part will focus on Health, Environment and Safety (HES) performance and Corporate Social Responsability (CSR). These laws, regulations and guidelines have become significant issues for industry and corporate, leading them to deploy an appropriate CSR strategy. The course will approach the case study in a corporate and another one about ICPE-Seveso for chemical substances and mixes.

The second part will focus on The river Loire valley. It has become a UNESCO World heritage location and contains different "Natura 2000" European sites. This course focuses the Loire Valley and some of the tributaries to facilitate the understanding of biodiversity conservation and ecological management. It includes the characteristics of the river Loire such as the variability of the flow, flooding periods, some of the animal and vegetal life but also natural habitats, in the water, on the sand banks or on the river banks. The course will also contain examples of disturbance and restoration along the river, in the hydraulic annexes or in other parts of the river basin. On the occasion, some examples of architectural spots along the river will also be added as point of interest for nature conservation.

| Skill bloc | ECTS credits |
|---|---|
| Scientific skills | Continuous assessmant (3ECTS) |

### Targeted skills

To manage CSR and environmental assessment in order to make a sustainable commitment in a responsible approach;To understand the key/fundamental principles of CSR, its challenges and its constraints; To be aware of the meaning of CSR diagnosis in business; To manage issues involving the environment in a changing world (climate, water, biodiversity and energy change); To put in place strategies to conserve energy, water, biodiversity, landscapes and resources and to reduce negative impacts on the environment ; To integrate principles of project management and tools of scientific analysis into effective environmental management.

### Speaker

Thierry ROLLAND Thierry.ROLLAND@ademe.fr

*Ingénieur thématique / Déchets des Activités Economiques*

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Jean-Baptiste Tissier jb@magrandeforet.fr

*CSR & Development MaGrandForêt*

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Guillaume Delaunay g.delaunay@parc-loire-anjou-touraine.fr

*Chef du Service Biodiversité et Paysages - Parc Naturel Régional Loire-Anjou-Touraine (PNRLAT)*

*Head of department « Biodiversity and landscapes » - Regional Nature Park Loire-Anjou-Touraine (RNPLAT)*

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Marie Fortin fortinmarie@yahoo.fr

*Freshwater biologist - Fédération de la Sauvegarde de l'Anjou*

## Part 1 : One Health and Environmental Sustainability: Zoonoses, Biodiversity & Ecological Networks (O. LATCHERE)
## 4h of lecture

**Sustainable Development & the One Health Framework**

Historical evolution of environmental protection (symptoms vs. root-cause approaches)
Principles of Sustainable Development: social, economic, environmental pillars
One Health concept: interdependence of human, animal, and ecosystem health
Examples of unsustainable human systems (transport, energy, waste) and their retrofit

**Biodiversity Decline & Ecological Continuities**

Global biodiversity trends (Living Planet Index) and primary drivers of loss
Ecological continuity components:
Reservoirs of biodiversity (core habitats supporting life cycles)
Ecological corridors linking cores (linear, stepping-stone, landscape)
Belt frameworks for connectivity:
Blue Belt (aquatic corridors, fish passages, sediment transit)
Turquoise Belt (land–water interface for amphibians, insects, birds, mammals)
Green Belt (terrestrial corridors, wildlife crossings, green roofs)
Brown Belt (soil function corridors, rain gardens, urban agriculture)
Aerial Belt (vertical connectivity for birds, bats, pollinators)
Black Belt (dark-sky zones for nocturnal fauna)
White Belt (acoustic refuges for sound-sensitive species)
Blue-Green Infrastructure in urban design: multi-belt integration

**Zoonotic Diseases — Emergence, Transmission & Drivers**

Link between habitat fragmentation, biodiversity loss, and zoonosis emergence
Transmission pathways: direct animal contact, environmental reservoirs, vectors, foodborne routes
Anthropogenic drivers: deforestation, agricultural intensification, urbanization, globalization, climate change
One Health risk management: ecological impact assessments, community-ecology approaches

**Antimicrobial Resistance as an Environmental Pollutant**

History of antibiotic discovery and rise of resistance
Environmental contamination pathways: wastewater, soil, wildlife reservoirs
Environmental resistome: gene exchange, selection pressure, spread to human pathogens
Mitigation strategies: policy measures, advanced wastewater treatment, soil remediation, alternative therapies

## Part 2 : ICPE & Seveso-III Regulations: Industrial Risk Management and Environmental Protection (T. Rolland)
## 4h of lecture, 2h of tutorials

**Evolution and Scope of Seveso Regulations**

Origins and milestones: Seveso I (1982), II (1996), III (2012) directives

Objectives: prevention of major-accident hazards and mitigation of impacts on health, safety, and the environment

Key EU chemical frameworks: CLP (Classification, Labelling, Packaging) and REACH (Registration, Evaluation, Authorisation & Restriction of Chemicals)

Hazard classification, pictograms, and Safety Data Sheet (SDS) requirements

**Major-Accident Causes, Consequences & EU Policy Integration**

Typical causes of industrial catastrophes: natural hazards, equipment failures, human error, overactivity, deliberate acts

Consequences: fires, explosions, toxic releases, environmental pollution, health impacts, economic losses

Synergies with related EU policies: civil protection, critical-infrastructure security, environmental liability, offshore safety

Case study overview: Lubrizol Rouen 2019 and its role in triggering French regulatory updates

**Post-Lubrizol Amendments & Internal Organization Plans**

2020 French decrees and orders affecting : all Seveso sites (reviews of hazard studies, inter-facility cooperation, regular exercises), storage warehouses (new ICPE sections, inventory rules, worker training), and flammable-liquid handling (mobile tank restrictions, spacing, firefighting resources)

The Internal Organization Plan (Plan d'Organisation Interne): content requirements, drill frequencies, remediation provisions

Distinction between PPRT (Technological Risk Prevention Plan) and the Internal Organization Plan

**ICPE Section Updates & Specific Warehouse Requirements**

Revised ICPE storage sections: 1510 (covered combustible warehouses), 1511 (cold stores), 1530/1532/2160 (paper, wood, grain), 2662/2663 (polymers, tyres)

Simplified project appraisal and double-classification avoidance

New obligations for all hazardous-material storage sites: • Annual physical inventory and weekly zone-based tracking of high-risk substances • Public-facing summary maps and emergency-response information • Fire-protection plans for new warehouses (fixed aerial tanks, water/emulsifier availability)

Best practices in risk prevention, emergency preparedness, and environmental sampling

**Type of continuous assessment** Written test

## Part 3 : Nature conservation management on the river Loire (G. Delaunay)
## 4h of lecture, 3h of tutorials and 4h of practical classes

Presentation of Regional Nature Park with the example of Loire-Anjou-Touraine. How to manage UNESCO World Heritage location. Case study of Loire Environnement in European Program for

Nature conservation (Natura 2000 areas : SPA (Special Protection Area) and SAC (Special Area of Conservation)).
Ecological course about flora and habitat types in the river Loire valley.
Tutorials will treat different management subject such as invasives, disturbances and restoration, wetlands and RAMSAR and troglodytes habitats.
A fieldtrip will bring concrete observation of Loire management.

**Type of continuous assessment**

Technical report : in group of 2 or 3, Students submit a **Short Scientific Paper** of less than 5 pages including pictures, key-words, executive summary and scientific references.

They have *usually* one month to produce this work in group. I collect it in mid-november.

## Part 4 : Ecological approach of river Loire (M. Fortin)
## 2h of tutorials and 3h of practical classes

This course unit is structured around four thematic modules, each reinforced by field observation and targeted tutorials:

River Typology and the Loire Basin : Definition and delineation of the Loire watershed; Structure and functioning of lotic (flowing-water) systems ; Common hydromorphological dysfunctions and principles of river restoration
Hydromorphological Diagnosis & Habitat Assessment; Diagnostic scales and ecological zonation of river reaches; Methods for evaluating habitat quality (substrate, flow diversity, cover); Case studies in fish-habitat restoration projects
Ichthyological Bioindication ; Fish-sampling protocols for wadeable rivers ; Calculation and interpretation of the Fish-Based Index (FBI)
Ecological Continuity & Migratory Species; Strategies for re-establishing longitudinal connectivity; Role of migratory fish as indicators of restored ecological continuities
Applied components: Fieldtrip to a Loire-valley restoration site

**Type of continuous assessment**

Report about ecological continuity management of Seine, Garonne, Adour and Rhône basins in pair.

## Master's degree Biodiversity, Ecology, Evolution

## Course Ecology and sustainable development

# 3UE21 – English

### General objectives

In today's corporate and academic environments, effective communication is essential. English is the world's most widely spoken language—used by over two billion people and many multinational organizations now require English proficiency for specific roles and for career advancement. Moreover, the vast majority of scientific publications in ecology and sustainable development are written in English. Consequently, strengthening your English skills is indispensable both for pursuing your professional objectives and for engaging with cutting-edge research.

| Skill bloc | ECTS credits |
|---|---|
| Knowledge transfer | Continuous assessmant (2ECTS) |

### Targeted skills

Demonstrate the ability to deliver clear and coherent individual and team presentations in English ; Produce, interpret, and critically analyze English language documents.

### Speaker

Nicholas LEWIS fishcomm@hotmail.com

*English lecturer*

## English (N. Lewis)
## 20 hours tutorials

The English course aims at allowing students to work five of the traditional language skills (written and oral comprehension, written and oral expression, and oral interaction) through various media (articles, documentaries, audio and video documents, graphics, etc.) and different activities (understanding, written expression, role plays, debates, oral presentations ...).

**Type of continuous assessment** Paired oral presentations
Written expression project

## English (Altissia Platform)
## 4 hours tutorials

In support of your academic and professional development in ecology and sustainable development, this course integrates the Altissia online platform to reinforce your English-language skills. Over the semester, each student is required to complete a minimum of four hours of guided study on Altissia; however, full access remains available year-round so you can continue to build proficiency whenever you choose.

Learning Objectives

Communicative Competence: Strengthen listening comprehension through authentic recordings (lectures, interviews, webinars) drawn from environmental and scientific contexts ; Expand speaking fluency with pronunciation and conversation exercises focused on key terminology in ecology, policy, and industry.

Reading & Writing Proficiency; Develop skimming and scanning strategies for academic articles, reports, and regulatory documents in English; Practice composing clear, concise emails, summaries, and short reports using discipline-specific vocabulary.

Domain-Specific Vocabulary & Grammar; Acquire and retain technical terms related to biodiversity, resource management, pollution control, and sustainable development; Master essential grammatical structures (passive voice, modal verbs, hedging language) to accurately describe processes, risks, and research findings.

Autonomous Learning & Digital Literacy ; Cultivate self-directed study habits by setting personalized learning goals, tracking your progress, and selecting modules that address your individual needs ; Gain familiarity with online learning tools—interactive exercises, pronunciation labs, and mobile apps—to support continuous improvement beyond the classroom.

Advised references

‘A silent Spring’ - Rachel Carson. - 1962

‘A silent spring revisited’ - Conor Mark Jameson - 2013

‘The Routledge Handbook for European Integration’ – Thomas Hoeber

‘Sapiens’ – A Brief History of Humankind – Yuval Noah Harari

‘The Hidden Life of Trees’ – Peter Wohlleben – 2015

‘Eating Animals’ – Jonathan Safran foer - 2009

## Master's degree Biodiversity, Ecology, Evolution

## Course Ecology and sustainable development

# 3UE12 - CA – Experimental project

***For students in initial training***

### General Objectives

Experimental project on a sustainable-development theme, using the UCO campus and the BiOSSE laboratory as a living laboratory.

Over one semester, each group will:

- Select and refine a project topic in ecological transition
- Plan and prepare concrete actions and materials
- Develop communication and outreach elements
- Implement and monitor their interventions

Throughout the term, groups receive regular, personalized tutorials with a dedicated faculty mentor to guide topic selection, experimental design, project management, and presentation skills.

| Skill bloc | ECTS credits |
|---|---|
| Professional skills | Continuous assessmant (2ECTS) |

### Targeted skills

To lead profesional or research project within the university related to Sustainable Development and/or environment ; To be able to communicate about the project ; To be able to select appropriate communication tools.

### Speakers

Amélie CHATEL achatel@uco.fr

*Course Manager « Ecology and sustainable development UCO master »*

*Professor at UCO, laboratory BIOSSE (Organisms Biology, Stress, Health, Environment)*

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Oihana LATCHERE olatcher@uco.fr

*Course Manager « Environmental Management and Sustainable Development » (M2 Ecology and sustainable development UCO)*

*Associate professor, laboratory BIOSSE 'Organisms Biology, Stress, Health, Environment)*

## Experimental project (A. CHATEL, O. LATCHERE)
## 12h tutorials

Select a topic and propose either a scientific research project or a responsible action plan tailored to the needs of UCO and/or the BiOSSE laboratory. Design and execute the experimental project from start to finish. Students will receive continuous support from a university faculty member throughout their project.

| | |
|---|---|
| **Type of continuous assessment** | Workshop/Conference + poster |

## Master's degree Biodiversity, Ecology, Evolution

## Course Ecology and sustainable development

# 3UE13 – FI – Project in workplace

***For students in apprenticeship***

### General objectives

In professional corporate operations, environmental and social considerations must be fully integrated. The primary objective of this course unit is for student teams to design and deliver an interactive sustainable-development initiative within a corporate setting. Over the semester, each group will receive personalized guidance from a faculty supervisor on all project phases—topic selection, action planning, communication strategy, and materials creation. Assessment will focus on both the execution of the initiative and the supporting communications (e.g. photographic documentation, participation statistics, engagement outcomes).

| Skill bloc | ECTS credits |
|---|---|
| Professional skills | Final exam (2 ECTS) / Continuous assessmant (1ECTS) |

### Targeted skills

Plan and implement a sustainable development initiative within a corporate environment ; Effectively communicate the project's objectives, processes, and outcomes to relevant stakeholders.

### Speakers

Oihana LATCHERE olatcher@uco.fr

*Course Manager « Environmental Management and Sustainable Development » (M2 Ecology and sustainable development UCO)*

*Associate professor, laboratory BIOSSE 'Organisms Biology, Stress, Health, Environment)*

## Project in workplace (A. CHATEL, O. LATCHERE)
## 24h tutorials

Students must select their workshop topic by mid-October. They will analyze the company's needs to design an appropriate workshop. They will develop and implement a communication plan using suitable tools. The workshop is scheduled to take place in December.

**Type of continuous assessment** Workshop in company + presentation (Photo-based presentation)