LaSalle

Beauvais • Institut Polytechnique

Sciences de la Terre, du Vivant et de l'Environnement

Syllabus 2015-2016

List of modules

Cross cultural communication (LE0201) 2
Water: current needs and further challenges (AE0202) 3
Water policy and governance (AE0203) 4
Surface hydrology (AE0204) 5
Hydrogeology (GE0206) 6
Fluid mechanics applied to groundwater (GE0205) 7
Aquatic chemistry (GE0208) 9
GIS applied to hydrology (AE0207) 11
Soil hydrogeochemistry (AE0209) 13
Flow and transport in groundwater (GE0210) 15
Ecological engineering applied to water management (AE0211) 17
Water quality management across agroecosystems (AE0212) 19
Water quality monitoring (AE0213) 21
Water pollution and remediation (GE0214) 23
Field trip (AE0215) 24
International seminars (AE0216) 25
French as a Foreign Language (LE0102) 26

About suggested readings

References beginning with the 🕮 symbol are available in the library.

Cross cultural communication (LE0201)

1 ECTS

Developping communication and project management skills in a multi-cultural team

Aim

Raising awareness and developing skills around culture and its impact on behavior in international teams. Students will draw on their own experience of learning within a multi-cultural team immersed in a host culture.

Program

- Culture: definitions, metaphors; key concepts. Culture as a source of intercultural errors
- Cross cultural communication: "Talk to me"
- Managing an international team: “When in Rome ... “ (case study; video)
- Cultural perceptions of water case study: description of geographical location, identification of stakeholders, proposal of technical and legal solutions
- Student reports: results of expatriate manager interview
- Student presentations of cross cultural training packages
- Independent/group work on assignments and projects

Learning outcomes

Upon successful completion of the workshop, students will be able to:

- Develop a better understanding of their own culture
- Explain how stereotypes are formed
- Understand how and why miscommunication happens
- Identify cross-cultural and intercultural perceptions of water management issues

Prerequisites

No pre-requisite.

Module leader

Martine REY (Ph.D.), Associate Professor, Languages & Cultural Studies.

Contact: martine.rey@lasalle-beauvais.fr

Water: current needs and further challenges (AE0202)

2 ECTS

A geography of water resources and of key issues to be adressed

Aim

This module is designed to be an introduction of the Spring Semester. Students will be initiated to the different stakes regarding water management that have to be challenged.

Program

- Basic water needs and implications for human health (water-related diseases)
- Geography of current water resources
- Methodologies to assess current water resources
- Indices of water scarcity
- Water needs by economic activities and by nation level of development
- Current and future threats to water resources (degradation of freshwater ecosystem, contamination, overexploration, climate change, *etc.*)

Learning outcomes

- Discuss the disparity between localization of water needs and of water resources
- Describe the methods to assess water scarcity
- Describe the different threats to water resources

Prerequisites

No prerequisite.

Module leader

Romain ARMAND (Ph.D.), Associate professor in surface hydrology and GIS.

Contact: romain.armand@lasalle-beauvais.fr

Water policy and governance (AE0203)

2 ECTS

Which instruments allow to supervise water management and to improve water services?

Aim

Water governance is defined by the political, social, economic and administrative systems that are in place, and which directly or indirectly affect the use, development and management of water resources and the delivery of water service delivery at different levels of society (*UNDP*). This module will give to students an overview of water governance: social, economic, politic and environmental dimensions will be studied.

Program

- Stakeholders involved in water use and management
- Territorial management of water
- Water rights and permits
- Water quantity and quality standards
- Tax incentives and credits.
- Conflict resolution

Learning outcomes

- Describe the different stakeholders related to water supply, use and management
- Discuss the different tools to regulate water use and water conservation

Prerequisites

No prerequisites

Module leader

Romain ARMAND (Ph.D.), Associate professor in surface hydrology and GIS.
Contact: romain.armand@lasalle-beauvais.fr

Surface hydrology (AE0204)

2 ECTS

Which processes are controlling the partition of rainfall?

Aim

The students will be familiarized with the processes explaining the partition of water in several hydrological fluxes (infiltration, runoff, recharge, evaporation). These processes will be studied at the catchment scale. The effect of soil surface state on runoff/infiltration partition will be specifically discussed because anthropogenic activities (crops, farming practices, urbanization, soil sealing, *etc*.) are permanently affecting the surface conditions and therefore the water fluxes.

Program

- Water cycle
- Rainfall data acquisition (gauges)
- Rainfall losses (interception, storage, infiltration)
- Runoff / infiltration partition
- Morphometric indexes of catchment
- Flood generation
- Water balance at the catchment scale

Learning outcomes

- Explain the surface hydrological processes and how they are affected by soil surface state
- Describe these hydrological processes by means of equations
- Delineate the catchment area based on topographic maps or data
- Interpret rainfall data
- Realize water balance

Prerequisites

No prerequisite.

Module leader

Romain ARMAND (Ph.D.), Associate professor in surface hydrology and GIS.

Contact: romain.armand@lasalle-beauvais.fr

Hydrogeology (GE0206)

2 ECTS

How to determine the physical properties of an aquifer ?

Aim

Groundwater constitutes a major water resource, especially for countries located in arid and semi-arid contexts. Student will be familiarized with theoretical knowledge of aquifers properties (which determine the water flows) and with field methods, thanks to our well field close to the campus and of our newly developed hydrogeology facilities.

This module is designed to give a very practical introduction to “Fluid mechanics applied to hydrogeology” and to “Flow and transports in groundwater”.

Program

- Aquifers typology (porous, fractured, karst, coastal) and geography
- Hydrodynamic parameters of aquifers: permeability, transmissivity, diffusivity.
- Assessment of aquifer recharge
- Issues regarding aquifers (subsidence, seawater intrusion, pollution, *etc*.)
- Aquifer protection (regulation)
- Operating exploration of the aquifers (wells, monitoring)
- Piezometric and sampling campaign around the on-site hydrogeology platform

Learning outcomes

- Describes the different types of aquifer and the impact on hydrodynamic parameters
- Discuss the susceptibility to issues, according to physical and geographical information
- Realize basic monitoring operations: depth measurement, water sampling.
- Solving exercises: compute water flow between two wells, draw piezometric map and assess the direction of water flow

Prerequisites

No prerequisite.

Module leader

Lahcen Zouhri (Ph.D.), Associate professor in hydrogeology.

Contact: lahcen.zouhri@lasalle-beauvais.fr

Fluid mechanics applied to groundwater (GE0205)

2 ECTS

Why a fluid moves in porous media?

Aim

The subsurface environment plays an important role in many human activities. For a sustainable use of the subsurface and its resource, it is extremely important to understand and predict the processes that occur in the subsurface. We will provide a rigorous methodology to study and applying subsurface flow dynamics through lectures, class exercises and case study demonstrations.

Program

- Hydraulic properties of fluids and porous materials: density, viscosity, pressure, hydraulic head, porosity, moisture content, capillarity, electrostatic forces of attraction, compressibility of the water and solid earth material, storage, intrinsic permeability, hydraulic conductivity, anisotropy and heterogeneity.
- Generalized fluid mass and momentum balance in free and porous media
- Macroscopic balance equations for three-dimensional flow of groundwater: continuity equation, motion equation, generalized Darcy's law, boundary conditions, flow equation for confined and phreatic aquifer and aquitard
- Two phase flow: wettability, capillarity, extended Darcy's law, relative permeability
- Infiltration: general infiltration model, physically based infiltration capacity equations, algebraic infiltration equation
- Modeling the movement of water through preferential flow paths: dual porosity model, film flow model
- Discussion on test cases and on reliability of results.

Learning outcomes

- Describe how the fluids move in free and porous medium
- Discuss the physical processes that governs the subsurface flow
- Apply techniques, skills and tools necessary to resolve subsurface flow hydraulic problems

Prerequisites

- Mathematics

Module leader

Claudia CHERUBINI (Ph.D.), Associate professor in hydrogeology.

Nicola PASTORE (Ph.D.), Research associate in hydrogeology

Contact: claudia.cherubini@lasalle-beauvais.fr; nicola.pastore@poliba.it

Aquatic chemistry (GE0208)

2 ECTS

How chemical processes are controling water composition ?

Aim

Across the aquatic system (rivers, oceans, lakes, groundwater), natural water presents differences in its composition. Several processes are driving the chemical composition of water system and their knowledge allows defining the hydrochemical context, based on present species and on geological background. Studying the hydrochemical context is essential to detect chemical anomaly which may indicate pollution.

A focus on chemical data representation will be done.

Program

- Natural water composition
- Chemical data and analysis
- Chemical water composition governing processes
- Natural hydrochemical processes (complexation, redox, hydrolysis, surface reaction)
- Data representation with software (GWB)

Learning outcomes

- Describe the chemical processes affecting water mineral composition
- Discuss how the presence of individual species, and their interactions, will affect the overall chemistry of a complex environmental system
- Represent water mineral composition with specific charts (Piper diagram).

Prerequisites

- Chemistry

Suggested readings

- 🕮 Langmuir, D. (1997) Aqueous Environmental Geochemistry. Prentice Hall, Upper Sadle River, New Jersey.
- 🕮 Stumm, W. and Morgan, J.J. (1996) Aquatic Chemistry, 3rd ed. Wiley Intersciences, New York.

Module leader

Olivier POURRET (Ph.D.), Associate professor in geochemistry. Contact: olivier.pourret@lasalle-beauvais.fr

GIS applied to hydrology (AE0207)

2 ECTS

How to create synthetis maps to obtain an accurate overview of watershed management?

Aim

Geographical Information Systems (GIS) are software commonly used to study water issues on a wide range of topics (watershed management, groundwater, floods, *etc*.). GIS constitute a focal tool which aggregates data from different sources and scales. In this module, students will be initiated to the ArcGIS software and to general GIS files (vectors, rasters and tables). Basic skills will be taught (data handling, mapping) and a focus will be done on the use of hydrological dataset.
The module will be designed to facilitate future use of other GIS than ArcGIS software.

Program

- Introduction to the different types of data
- Software basic handling
- Realization of a map: which information should be provided?
- Extraction of dataset from web libraries (USGS)
- Use of elevation dataset (SRTM)
- Creation of topographical and hydrological raster files: slope, indexes (Beven-Kirkby, TPI), catchment delineation, direction and accumulation flow, stream network generation
- Export (other GIS, web-based solutions)
- Use of GPS device and import into the software
- Application to watershed management and water resources management

Learning outcomes

- Describe the different GIS data
- Realize maps
- Create hydrological data from elevation dataset
- Search and download on-line free dataset

Prerequisites

No prerequisites

Module leader

Romain ARMAND (Ph.D.), Associate professor in surface hydrology and GIS. Contact: romain.armand@lasalle-beauvais.fr

Soil hydrogeochemistry (AE0209)

2 ECTS

How to determine the fate of water and chemical elements in the soil-water continuum?

Aim

Soils are heterogeneous systems with many important reactions occurring at the interface between solid, liquid and gas phases. The fate of chemicals that impact terrestrial and aquatic systems is controlled largely by their behavior at these interfaces. The soil physics (structure, moisture) determine the balance between runoff and infiltration and thus control the variability of streams flow and of groundwater table level. Soils also constitute a place of interactions with many anthropogenic inputs such as fertilizers. This course focuses on the main soil physico-chemical processes that control the transfer of chemical elements through environment and their consequences on water quality. The course will cover the fundamentals of soil water movement, solute-solid interactions, biogeochemical cycles of elements and impacts of agricultural practices on water quality. Real issues related to the transfer of elements within the soil-water continuum will be explored through independent literature research and class discussion.

Program

- Soil Physics
- Soil and aqueous environmental geochemistry
- Water movements in the soil porous media
- *In situ* moisture and infiltration measurement across different soil and topographic conditions
- Biogeochemical cycles (N, P, Ca, Mg …) and their characterization
- Factors affecting elements transfer across environment
- Impacts of agricultural N and P inputs on water quality

Learning outcomes

- Prepare a campaign of soil sampling
- *In situ* measurements and calculation of main physical properties of soil (bulk density, soil moisture, infiltration)
- Understand how soil processes are responsible for the transfer of chemical elements to water
- Characterize biogeochemical cycles and fluxes of elements across different reservoirs using innovative analytical tools (*e.g.* stable isotopes)
- Discuss how human activities may affect the physical properties of soil and disturb the different steps of biogeochemical cycles

- Discuss how agriculture practices impact water and environmental quality

Prerequisites

- Introduction to soil science
- Analytical chemistry

Module leader

David HOUBEN (Ph.D.), Associate professor in soil science and biogeochemistry.

Contact: david.houben@lasalle-beauvais.fr

Flow and transport in groundwater (GE0210)

2 ECTS

How to choose and model the processes that are controling subsurface flow and transport?

Aim

The fate of pollutants that enter the subsurface is determined by physical, chemical, and biological processes. Depending on the relative significance of these processes, the pollutants may spread in the subsurface, may be kept in place and rendered immobile and/or may be transformed into other substances. We will introduce these processes, explain their physical basis, describe their effects, provide governing equations, and develop solutions for simple situations. Conceptual model development, numerical model implementation and model calibration will be discussed in order to examine specific flow and transport applications. Exercises and practice will be alternated to support the concepts discussed in the course.

Program

- Transport processes: advection, diffusion, dispersion
- Mass transfer processes: adsorption, precipitation, radioactive decay, biodegradation, inactivation
- Reactive transport: equilibrium and non – equilibrium model, competitive and chain reaction
- Flow and transport governing equations and boundary conditions.
- Modeling the transport of contaminants through preferential flow paths: dual porosity model, transport in fractured porous media
- Modeling seawater intrusion in coastal aquifers: density dependent groundwater flow and contaminant transport.
- Conceptual model development using borehole data, cross-sections and aquifer test analysis
- Flow and transport model development, model calibration, choice of appropriate boundary conditions.
- Discussion on test cases and on reliability of results.

Learning outcomes

- Describe how the contaminants migrate in the groundwater
- Discuss the physical processes and the modeling techniques that govern the fate of contaminants in aquifers.
- Apply techniques, skills and tools necessary to resolve flow coupled with contaminant transport problems

Prerequisites

- Aquatic chemistry
- Hydrogeology
- Fluid Mechanics applied to groundwater

Suggested readings

Module leader

Claudia CHERUBINI (Ph.D.), Associate professor in hydrogeology.

Nicola PASTORE (Ph.D.), Research associate in hydrogeology

Contact: claudia.cherubini@lasalle-beauvais.fr; nicola.pastore@poliba.it

Ecological engineering applied to water management (AE0211)

2 ECTS

What are applications of wetland ecosystems and functional plant traits in ecological engineering?

Aim

In this module, students will be familiarized with ecological engineering, in particular influence of plant species diversity and plant traits on the physical and biogeochemical processes of water and nutrient flows. Natural areas such as wetlands will be particularly studied as they are high biodiversity ecosystems and present functions in water protection. Therefore, wetlands are particularly focused by stakeholders and are concerned by conservation measures.

Land planning is now enhanced by the possibilities of plant-based engineering. Artificial wetland may be used for wastewater phyto-treatment technologies. Runoff and erosion in agricultural catchments can be reduced by herbaceous hedges inspired by plant morphology and other properties.

Program

1- Wetland ecology and applications in ecological engineering for water protection and treatment

- Ecosystem services of wetlands
- Impact of wetlands on water quality (nitrate and phosphate removal)
- Wetland reconstruction or restoration to improve water protection
- Visit: waste water treatment plant based on plant-based engineering

2. Plant functional ecology and applications in ecological engineering to reduce runoff and erosion

- Effect of plant traits on efficiency of herbaceous hedge to concentrated runoff
- Effect of cover crops (e.g. multispecies cover crops) on runoff generation and erosion
- 1 day field trip: Pays de Caux (agricultural area strongly affected by runoff issues)

Learning outcomes

- Describe the functional role of different types of plants in wetlands
- Describe the key processes of importance for nutrient removal in wetlands
- Discuss the choice of techniques to reduce the impacts of runoff through a case study

Prerequisites

No prerequisite.

Module leader

Michel-Pierre FAUCON (Ph.D.), Associate professor in plant ecology.

Contact: michel-pierre.faucon@lasalle-beauvais.fr

Water quality management across agroecosystems (AE0212)

2 ECTS

How to adapt farming practices to reduce agricultural impacts on water quality?

Aim

Agricultural practices, especially the use of nutrients and plant-health products, can degrade chemical quality of surface water and of groundwater. This module is designed to provide an agronomy background to students to understand how farmers may conciliate their yield goals, crop needs and water quality. A focus on major nutrients (nitrates and phosphorus) will be done.

This theoretical knowledge will be applied to the Pisa floodplain (Italy) where different crop systems or land use managements are tested to identify the impacts of farming practices on water quality. This area is illustrative of Mediterranean coastal areas periurban dynamics (urban sprawl, land abandonment).

Program

- Introduction to agronomy
- Nutrient balance
- Regulatory context of farming practices regarding water quality
- Overview of agro-environmental measures in the EU
- Hydrology applied to agroecosystems
- Fate of phosphorus: anthropogenic and natural sources; transfer and impact on water quality
- Use of spatialized modelling tools

Learning outcomes

- Describe the interaction between farming practices and water quality
- Describe the agro-environmental measures that may be used to conserve water quality
- Realize a nutrient balance

Prerequisites

- Aquatic chemistry
- Soil hydrogeochemistry
- Ecological engineering applied to water management
- Water policy and governance

Module leader

Elisa MARRACCINI (Ph.D.), Associate professor in agronomy and geo-agronomy.

Contact: elisa.marraccini@lasalle-beauvais.fr

Water quality monitoring (AE0213)

2 ECTS

How to assess the ecological and physico-chemical quality of water systems?

Aim

Determining water quality is a key question in the EU where Water Framework Directive (WFD) aims at achieving an ecological and chemical "good status" of all water bodies. In this module, we will focus on superficial water bodies (*e.g.*: rivers and lakes) and the way to assess the status of their biological and physico-chemical status by means of sampling, indicators and laboratory analysis. Anthropogenic perturbations (sewage effluents, agricultural practices) and their effects on water quality will be particularly studied.

Stream station(s) near Beauvais will be used to perform water and biological samples.

Program

- Animal and vegetal bio-indicators
- Review of water biological quality indexes
- In-site physico-chemical measurement (multiparametric probe)
- Macro-invertebrates sampling in stream stations near Beauvais
- Recognition of the taxonomic rank of sampled macro-invertebrates
- Determination of biological index of the selected stream station(s)
- Lab measurements of physico-chemical parameters (pH, Nitrate, Chlorine, etc.)
- Introduction to sensors involved in monitoring of water properties

Learning outcomes

- Explain the location of the sampling site depending on expected anthropogenic perturbation
- Assessing first ecological level of a water system
- Measuring basic physico-chemical parameters of water samples
- Discuss the effects of environmental and anthropogenic factors on biological index or physico-chemical parameters

Prerequisites

- Aquatic chemistry

Module leader

Anne-Maïmiti MERCADAL (Ph.D.), Associate professor in animal ecology.

Contact: anne-maimiti.mercadal@lasalle-beauvais.fr

Water pollution and remediation (GE0214)

2 ECTS

How to characterize a water pollution and propose specific remediation techniques?

Aim

Preventing and controlling pollution of the environment is a major challenge facing both developed and developing countries. In this module, students will be initiated to the major environmental pollutants and to the current methods used to control soil and water pollutions.

Program

- Different types of organic and inorganic contaminants in surface water and groundwater
- Document review of a contaminated site
- Diagnostis of a contaminated site
- Management process of contaminated site
- Remediation techniques of contaminated water and soils

Learning outcomes

- Describe the different types of contaminants and their behavior in surface water and in groundwater
- Based on document review, summarise the key factors and processes that are controling pollution
- According to site context,disccuss the choice of the most accurate remediaition technqiue

Prerequisites

- Aquatic chemistry
- Water flow and transport

Suggested readings

- 🕮 Appelo, C.A.J. and Postma, D. (1999) Geochemistry, groundwater and pollution. A.A. Balkema, Rotterdam.

Module leader

Olivier POURRET (Ph.D.), Associate professor in geochemistry.

Contact: olivier.pourret@lasalle-beauvais.fr

Field trip (AE0215)

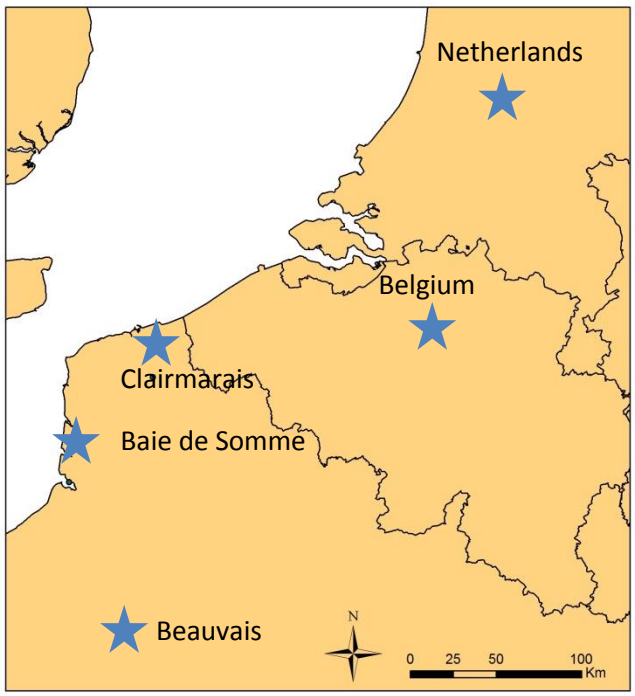
2 ECTS

Study and visit of sites presenting specific water management facilities

Program

Program of field trip is still under construction. It may include:

- Visit of "Baie de Somme" (Somme Bay). This estuary area is experiencing deposition issue which leads to silting of the bay. Fishing boats cannot access the whole bay because of low seawater depth. Hydraulic facilities have been built to push sediments away from the bay.
- Visit of marsh of Audomarois (UNESCO biosphere). Besides its ecological interest, this wetland is an historical place of vegetable production on plots separated by ditches
- Visit of Belgium: management of runoff generated on farmlands, contaminated sites.
- Visit of Netherlands: polder, drainage system and city expansions on below sea level areas.



Module leader

Romain ARMAND (Ph.D.), Associate professor in surface hydrology and GIS.

Contact: romain.armand@lasalle-beauvais.fr

International seminars (AE0216)

1 ECTS

International point of view about water and environmental management

Aim

As spring program is limited to 4 months, the seminars provide opportunity to raise new topics and give prime examples of water management. The seminars will be given by professors from partner universities or specialists from public and private institutions.

Program

Program is still under construction, it may include:

- Mapping the agricultural use of soils based on remote sensing analysis.
- How increase agriculture tolerance to drought and soil salinization?
- New technics of water depollution
- Integrating climate change in management plans of water basin area
- How to monitor and reduce water consumption thanks to digital techs?
- How to feed growing cities with fresh water in semi-arid context?

Prerequisites

No prerequisites.

Module leader

Romain ARMAND (Ph.D.), Associate professor in surface hydrology and GIS.
Contact: romain.armand@lasalle-beauvais.fr

French as a Foreign Language (LE0102)

2 ECTS

Discovering French language

Aim

This module is designed for students who have had little or no previous French instruction. Students will discover French and acquire some basic tools for real-life language use while they study and travel in France.

Class will be conducted entirely in French, and students will be expected to participate actively, using the language skills they are learning inside and outside the classroom. In the end, students are encouraged to pursue the study of French once they return to their home institutions.

Program

- Describe, narrate, and ask/answer questions in the foreign language in the present time about a variety of topics related to family, daily activities, eating, and traveling.
- Comprehend the foreign language with sufficient ability to grasp the main idea in short conversations pertaining to the topics mentioned above.
- Read and understand the main idea and some details of materials related to daily life and travel (maps, classified ads,)
- Write sentences and short paragraphs on familiar topics relating to personal interests and practical needs. (e.g. postcards)

Prerequisites

No prerequisite.

Module leader

Martine REY, Associate Professor, Languages & Cultural Studies.

Contact: martine.rey@lasalle-beauvais.fr

2016 Water and Environmental Management Program

JANUARY	FEBRUARY	MARCH	APRIL	MAY
	Cross cultural communication 1 ECTS	Aquatic chemistry 2 ECTS	Holidays	Labor Day
				Water pollution and remediation 2 ECTS
			Fluid mechanics applied to hydrogeology 2 ECTS	Ascension Day
		Soil hydrogeochemistry 2 ECTS		
	Water policy and governance 2 ECTS			V Day
				Field trip 2 ECTS
		GIS applied to hydrology 2 ECTS	Flow and transport in groundwater 2 ECTS	
	Surface hydrology 2 ECTS			Whit Monday
Welcome day			Water quality monitoring 2 ECTS	
Logistical and administrative issues		Ecological engineering applied to water management 2 ECTS		
	Hydrogeology 2 ECTS			
Water: current needs and further challenges 2 ECTS		Easter Holidays	Water quality management across agroecosystems 2 ECTS	

WE · National Holiday · Classe

International seminars (6 sessions throughout the semester - 1 ECTS)

2 hours per week of French as a Foreign Language courses (2 ECTS)

Exams are usually planned at the end of each week

LaSalle

Beauvais · Institut Polytechnique

Earth, Life and Environmental Sciences

Admissions

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- **Deadline for sending application: October 15, 2015**
- **Application forms are available on our website: www.lasalle-beauvais.fr/ -Study-at-LaSalle-Beauvais-**
- **Contact:** incoming@lasalle-beauvais.fr