



UNIL | Université de Lausanne

Faculté des géosciences
et de l'environnement

Maîtrise universitaire ès Sciences en sciences de
l'environnement
Master of Science (MSc) in Environmental Science

| Faculty of Geosciences and Environment
| University of Lausanne

Study Plan

Applicable from | 17 september 2024



Faculty of Geosciences and Environement | www.unil.ch/gse

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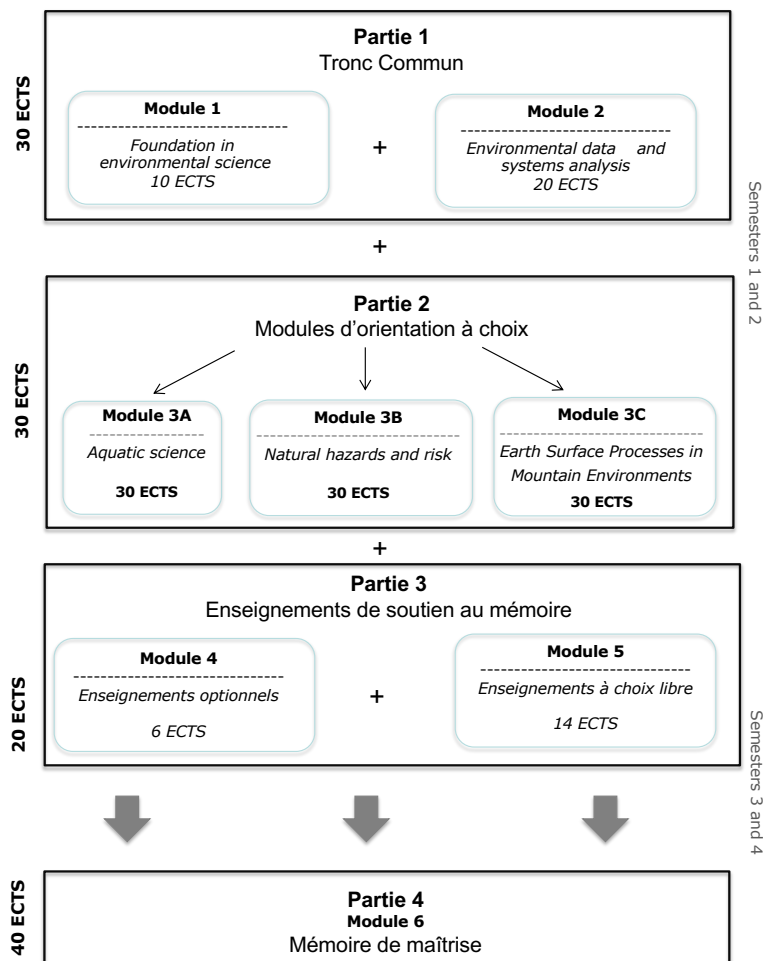
2024- 2025

Study Plan

Note: This document is a translation from the original document in French. In case of discrepancies, only the original version in French is binding.

The Master of Sciences (MSc) in Environmental Science is organised by the Faculty of Geosciences and Environment of the University of Lausanne.

This 120 ECTS credit 2nd cycle programme is scheduled to last 4 semesters. Compulsory courses are taught in English. If English is used, the teacher concerned must ensure that they comply with Directive 3.4 of the University Direction.



General framework

The syllabus for the Master of Science in Environmental Sciences is divided into four parts:

Part 1: a core curriculum of 30 ECTS, comprising two modules

Module 1 « *Foundations in environmental science* » (10 crédits ECTS)

Module 2 « *Environmental data and systems analysis* » (20 crédits ECTS)

Part 2 : an orientation section of 30 ECTS

Orientation A « *Aquatic science* » (30 ECTS), one teaching module

Orientation B « *Natural hazards and risk* » (30 ECTS), one teaching module

Orientation C « *Earth surface processes in mountain environments* » (30 ECTS), one teaching module

Part 3: two teaching modules in support of the Master's thesis for a total of 20 ECTS credits. Students may do a work placement in a company or an administration.

Part 4: a Master's thesis (40 ECTS credits)

The course may be **assessed** in one of the following ways:

- written examination (between 2 and 4 hours, during an examination session)
- oral examination (between 15 and 30 minutes, during an examination session)
- validation: continuous assessment (at least two validations), practical work (report, seminar, etc.) provided as part of the course.

Prerequisites : The courses indicated as prerequisites are considered to essential for following the courses in the Master of Science in Environmental Science programme.

Part-time studies : Students enrolled in part-time studies (see Directive 3.12) must comply with the indications relating to the semester and year in which each course must be taken. These recommendations appear in the last column of the tables detailing the Study Plan (SA = autumn semester, SP = spring semester, followed by a number indicating the semester number).

Legend for the teaching chart

1. Teachers : N.N. = teacher to be designated
2. Type of teaching: C = course ex cathedra, T = field work, TP = practical work, S = seminars
3. Hours: total effective hours corresponding to the duration of the teaching; db = teaching given in the form of a block day; djb = half-day block.
4. ECTS credits: one ECTS credit is equivalent to 25-30 hours of actual work.
5. Assessment: each course is assessed by a written or oral examination or by validation (continuous assessment, practical work, etc.). Examinations are organised during examination sessions and validation takes place during the semester.

Part 1: Core syllabus (30 ECTS)

The core syllabus applies to all students enrolled in the programme. The core syllabus is divided into two modules. For part-time students, the core modules must be completed by the end of the second year (SP4)¹.

Module 1 « Foundations in environmental science »

Teaching	Teachers	Hours per Semester	Examinations	ECTS Credits	Part Time
Masters Project Preparation	P. de Anna (coord) G. Mariethoz	Autumn 20 C,TP & Spring 10 C,TP	Validation	4	SA3 SP4
Applications of environmental science seminar series	N. Chèvre (coord) M.-H. Derron S. Lane intervenants	Autumn 12 S	Practical work	1	SA1
Statistical Analyses in Environmental Sciences	X. Dupla O. Broennimann	Spring 27, C,TP	Oral Exam Practical work	3	SP2
Introduction to Scientific Programming with Python	T. Beucler	Autumn 16, C/TP	Practical work	2	SA3
Total credits required for this module				Total	10

Examination:

The module is passed if the average of the grades weighted by the ECTS credits of the examinations is greater than or equal to 4.0 and if at least 80% of the total credits for the module correspond to grades of at least 4.0 or "passed" validations.

Module 2 « Environmental data and systems analysis »

The student chooses courses from among those offered for a total of 20 ECTS.

Teaching	Teachers	Hours per Semester	Examinations	ECTS Credits	Part Time
Model parameter estimation and uncertainty quantification	N. Linde (resp.) J. Hunziker	Spring 48 C,TP	Practical work	5	SP2
Laboratory methods: experiments, measurements and uncertainties	P. de Anna	Spring 48 C,TP	Practical work & Oral Exam	5	SP4
Environmental time-series analysis	J. Irving	Autumn 48 C,TP	Practical work & Written Exam	5	SA1
Remote sensing of Earth systems	G. Mariethoz G. Antoniazza	Autumn 48 C,TP	Practical work	5	SA1
Machine Learning for Earth and Environmental Sciences (<i>Ce cours a lieu en 2ème année</i>)	T. Beucler	Autumn 48 C,TP	Practical work	5	SA5
Scientific computing	Y. Podladchikov	Autumn 48 C,TP	Practical work	5	SA3
Advanced Geospatial Data Analysis – practical concepts and environmental applications	M. Tonini	Spring 48 C, TP	Practical work	5	SP4
Total credits offered for this module				35	
Total credits required for this module				Total	20

The student is not permitted to register more ECTS credits than the number required for the module.

Examination:

The module is passed and ECTS credits awarded when the ECTS-credit-weighted average of the examinations of the lessons chosen in the module is equal to or greater than 4.00.

¹ In the tables, SA and SP stand for Autumn Semester and Spring Semester respectively.

Part 2 : Orientation (30 ECTS)

Students choose one of three options. Each option consists of a module.

Orientation « Aquatic science » (30 ECTS)

The aim of the "Aquatic Sciences" programme is to provide multidisciplinary expertise on issues relating to continental waters. It has been designed and built from a global perspective, integrating the aquatic continuum typical of the Swiss landscape, for which the mountains literally play the role of "water towers". This formation explicitly integrates the hydrological link between the glaciers and the environments at altitude, the soil and subsoil, towards the rivers and lakes of the foothills. This perspective, which is unique in the landscape of Swiss university courses, means that issues relating to surface and groundwater can be tackled on the scale of catchment areas, a unit for environmental management and a fundamental understanding of the impact of man on the quantity and quality of water.

At the end of the Master's programme, students should be able to:

1. Master the basic tools for studying water flows, tracing their origin and residence time in soil, rivers and lakes, and studying their chemical and biological quality, both in the laboratory and in the field.
2. To adopt a multidisciplinary approach to issues relating to the availability and quality of surface and groundwater.
3. Integrate notions of the different spatial and temporal scales involved in water-related issues.
4. Construct and manage data collection programmes relating to these issues, including their numerical analysis.
5. Identify governance issues and public policies relating to water in Switzerland.

Module 3A « Orientation Aquatic science »

Teaching	Teachers	Hours per Semester	Examinations	ECTS Credits	Part Time
Solute transport in watersheds	P. Benettin	Autumn 26 C,TP	Practical work & Oral Exam	3	SA3
Environmental toxicology	N. Chèvre	Autumn 30 C,TP	Practical work	3	SA1
Soil and Water Chemistry	M. Keiluweit	Autumn 39 C, TP	Practical work & Written Exam	4	SA1
Aquatic ecosystems: glaciers, rivers, and lakes	M.-E. Perga S. Lane G. Antoniazza	Spring 48 C,TP	Practical work	5	SP2
Aquatic ecosystems : consultancy proposals, analyses and reports	S. Lane	Autumn 2sd year 40 T	Practical work	4	SA2
Tracing biogeochemical processes and fluxes using isotope analysis	T. Vennemann	Autumn 20 C,TP	Practical work	2	SA1
Field and laboratory methods (I): The UNIL campus as a microcosm	J. Berg (resp) N. Chèvre T. Vennemann	Spring 60 C, TP	Practical work	5	SP2
Field and laboratory methods (II): Alpine catchments (Le terrain peut se dérouler en dehors des périodes de cours)	M.-E. Perga S. Lane	Spring Autumn 50 T,C	Practical work	4	SP4
Total credits required for this module			Total	30	

Examination:

The module is passed and ECTS credits awarded when the ECTS-credit-weighted average of the examinations of the lessons chosen in the module is equal to or greater than 4.00.

Orientation « Natural hazards and risk » (30 ECTS)

The "Natural Risks and Hazards" specialism offers training in the analysis of natural risks, from the study of physical processes to their management, including the quantification of their probability of occurrence (hazard).

The main components of this training are :

- 1) Study of physical processes: acquisition and analysis of basic data, mapping, analysis and modelling of mechanisms, monitoring techniques. In this part, the emphasis is on gravity hazards (landslides, rockfalls, floods, avalanches, etc.).
- 2) Risk assessment and its various components (hazards, vulnerability, resilience, quantitative risk assessment: QRA, etc.)
- 3) Risk management, warning systems, development and assessment of mitigation strategies.
- 4) Risk communication.

This area includes field activities, laboratory work and numerical modelling. It also includes contributors from risk management practice.

At the end of the Masters, students should be able to:

- Understand the processes behind the main natural hazards. Acquire and analyse data relating to these phenomena in the field and in the laboratory.
- Construct a conceptual model of a hazard. Master the basic tools of numerical modelling of the phenomena concerned.
- Carry out a quantitative analysis of the risks associated with natural phenomena.
- Propose risk reduction measures
- Identify the wider issues of risk management and communication.

Module 3B « Orientation Natural hazards and risk »

Teaching	Teachers	Hours per Semester	Examinations	ECTS Credits	Part Time
Communication on environmental risks	M. Jaboyedoff	Autumn 32 C,TP	Practical work	3	SA1
Advanced quantitative risk and vulnerability	M. Jaboyedoff	Autumn 40 C,TP	Oral Exam	3	SA1
Risk quantification and insurance	M. Jaboyedoff (resp) L. Marescot	Spring 20 C, TP	Practical work	2	SP4
Risk management (monitoring, early warning, post-disaster preparedness)	M. Jaboyedoff speakers	Spring 20 C, TP, T	Practical work & Oral Exam	2	SP2
Erosion and slope movements	M. Jaboyedoff (resp) A. Abellan	Spring 48 C,TP	Practical work & Oral Exam	5	SP2
Monitoring techniques for slope dynamics	M.-H. Derron	Autumn 48 C,TP	Practical work	5	SA3
Hazards and risks of slope mass movements: field camp	M.-H. Derron M. Jaboyedoff	Spring 80 T	Practical work	5	SP2
Flood risk modeling	S. Lane G. Antoniazza speakers	Spring 48 C,TP	Practical work	5	SP4
Total credits required for this module			Total	30	

Examination:

The module is passed and ECTS credits awarded when the ECTS-credit-weighted average of the examinations of the lessons chosen in the module is equal to or greater than 4.00.

Orientation « Earth Surface Processes in Mountain Environments » (30 ECTS)

The aim of the "Earth Surface Processes in Mountain Environments" programme is to train students in the analysis of active surface processes in mountain environments. The emphasis is on characterising processes, processing and analysing data, learning study methods and modelling processes. Training takes the form of lectures, practical work and field measurements.

At the end of the Master's programme, students should be able to:

1. Describe and analyse natural processes in mountain regions, using appropriate methodological tools.
2. Master the practical use of different analysis methods (field, modelling, laboratory, cartography and remote sensing).
3. Collect, process and analyse information and data from the field.
4. Gain a critical understanding of the complexity of surface processes in mountain areas and the issues involved in planning mountain regions.
5. Communicate the results of research into the analysis of surface processes in mountain areas, orally and in writing, to a variety of audiences.

Module 3C « Earth surface processes in mountain Environments »

Teaching	Teachers	Hours per Semester	Examinations	ECTS Credits	Part Time
Alpine periglacial environments	C. Lambiel	Autumn 40 C,TP,T	Practical work	4	SA1 SA3
Monitoring techniques for slope dynamics	M.-H. Derron	Autumn 48 C,TP	Practical work	5	SA3
Aquatic ecosystems: glaciers, rivers, and lakes	M.-E. Perga S. Lane G. Antoniazza	Spring 48 C,TP	Practical work	5	SP2
GIS-based analysis for mountain geomorphology	C. Lambiel	Spring 28 C,TP	Practical work	3	SP2 SP4
Aquatic ecosystems : consultancy proposals analyses and reports	S. Lane	Autumn 2sd year 40 T	Practical work	4	SA3 SA5
Erosion and slope movements	M. Jaboyedoff	Spring 48 C,TP	Practical work & Oral Exam	5	SP2
Dates and rates of Mountain evolution	G. King	Autumn 40 C,TP,T	Practical work	4	SA3
Total credits required for this module			Total	30	

Examination:

The module is passed and ECTS credits awarded when the ECTS-credit-weighted average of the examinations of the lessons chosen in the module is equal to or greater than 4.00.

Part 3 : Master's thesis support course (20 ECTS credits)

Students complete their academic programme with optional courses in agreement with the Master's thesis director: the courses must be chosen to support the preparation of the Master's project. This third part consists of two modules: 4 and 5. For module 4, students choose a total of 6 ECTS from the list below.

Module 4 : optional courses

Teaching	Teachers	Hours per Semester	Examinations	ECTS Credits	Part Time
Watershed and river network modelling	N. Peleg	Spring 24 C,TP	Practical work	3	SP4
Weather and climate dynamics	D. Domeisen	Spring 27 C,TP	Practical work	3	SP4
Mountain ecosystems; ecology and evolution Cours	A. Guisan	Spring 28 C	Practical work	3	SP2 SP4
Mountain ecosystems ; ecology and evolution Terrain (cours est obligatoire pour faire le terrain)	A. Guisan	Spring 52 T	Continuous assessment	4	SP2 SP4
Principle of scientific data acquisition	C. Schmidt	Autumn 24 C, TP	Practical work	3	SA3
Total credits required for this module			Total	6	

Module 5 : free choice courses

For module 5, in agreement with their Master's thesis director, students may choose Master's courses given either within the Faculty or at UNIL, or in programmes at Swiss or foreign universities, for a total of 14 ECTS. Bachelor's level courses may be offered for a maximum of 6 ECTS credits. Tutorial work may be recognised for a maximum of 5 ECTS credits.

Once students have chosen their courses for the two modules, they complete the "Options Form", submit it to the Master's thesis director for approval and signature, and then send it to the Master's secretariat.

It is also possible to register an internship in module 5, provided that it has been approved in advance by the Master's Scientific Committee. The number of credits attributed to the internship depends on the duration of the internship, with a maximum of 14 ECTS for a three-month internship. The evaluation of the placement is based on the writing of a report, an evaluation by the supervisor in the host organisation, as well as an oral presentation for placements awarded 10 ECTS or more.

Examination of part 3 :

Each module in part 3 (4 and 5) is passed and gives rise to the award of ECTS credits (6 ECTS for module 4 and 14 ECTS for module 5) when each examination is passed independently by obtaining a minimum grade of 4.0 or an "passed" assessment.

Part 4: Master's thesis (40 ECTS credits)

The final part is reserved for personal research work, the Master's thesis, which is worth 40 ECTS credits. The Master's thesis is normally submitted at the end of the 4th semester. It is the logical continuation of the teaching modules. The Master's thesis must be written in the chosen subject area. A teacher from the compulsory first-year courses is normally appointed as Master's thesis supervisor. A lecturer from the Faculty may also supervise a Master's thesis, with the agreement of the Scientific Committee, which appoints one of its members as rapporteur.

The Master's thesis module is passed and the 40 ECTS credits are awarded if the grade reflecting the quality of the research, the quality of the writing of the Master's thesis and the defence is equal to or higher than 4.00.

Adopted by the Faculty Council on 11 April 2024

Addenda

INFORMATION IMPORTANTE

La pandémie nous a montré que des circonstances indépendantes de notre volonté peuvent nous amener à devoir apporter les adaptations suivantes aux plans d'études en cours de semestre :

- possibilité de passer d'un mode d'enseignement à un autre (présentiel <—> à distance, synchrone <—> asynchrone, passage à l'enseignement co-modal là où il n'était pas prévu au départ).
- modification des modalités d'évaluation, **sans induire de dérogation aux Règlements d'études** (oral <—> écrit, examen <—> validation, travail individuel <—> travail en groupe, travail pratique <—> travail théorique, évaluation en présence <—> évaluation en ligne, etc.)
- modalités alternatives ou décalées dans le temps pour les enseignements, stages, travaux pratiques, terrains et camps qui ne pourraient avoir lieu ou les enseignements qui ne pourraient plus avoir lieu dans la forme initialement prévue.

Réserve adoptée par la Direction de l'Université de Lausanne, le 1^{er} juillet 2022