STUDY GUIDE

Master’s Degree Programme in Environmental Sciences
2018/2019
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This study guide provides practical information on the Master’s Degree Programme in Environmental Sciences. Further sources of information are given in the text and specifically in section 9. The information about lectures in this guide is as accurate as the publishing date. The most up-to-date and additional information is given in the course catalogue www.vvz.ethz.ch.

The legally binding document for the Master's degree programme in Environmental Sciences is the German version of the Programme Regulations for the Master of Science ETH in Environmental Sciences (Studienreglement 2013 für den Master-Studiengang Umwelt Naturwissenschaften, Ausgabe 22.05.2015-2).

**Students are requested to visit the departmental website for further information under www.usys.ethz.ch.**

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Explanations and acronyms
The course lists in sections 3 to 6 show course number, course title, semester (HS=autumn, FS=spring), number of hours, course type and credits available.

Additional remark: the language of instruction is mainly English for the Master’s degree programme in Environmental Sciences. A few lectures are offered in German. Please refer to the course catalogue where the language of instruction is given for each lecture.

Explanations
[Abbreviations as used in the course catalogue]
A = independent project (Selbstständige Arbeit)
BSc = Bachelor
CP = credit points
D = Master’s Thesis (Master-Arbeit)
D-USYS = Department of Environmental Systems Science
E = excursion (Exkursion)
FS = spring semester (Frühjahrsemster)
G = lecture incl. exercises (Vorlesung mit Übung)
HS = autumn semester (Herbstsemester)
h = e.g. “180 h”: total number of contact hours (during or after the semester)
K = colloquium (Kolloquium)
max = maximum
min = minimum
MSc = Master
P = practical course (Praktikum)
S = seminar (Seminar)
U = exercises (Übung)
V = lecture (Vorlesung)
1,2,... = contact hour[s] a week (Semesterwochenstunde/n)
1 Environmental Sciences at ETH Zurich

1.1 Why Environmental Sciences?

Ideen können nur nützen, wenn sie in vielen Köpfen lebendig werden
Alexander von Humboldt (1769 – 1859)

Ideas can only prosper if they become alive in the minds of many

Today’s society is confronted by large scale environmental problems: the excessive use of natural resources, destruction and degradation of wildlife habitats, climate change and others. Almost all of these problems result from the fact that human activities are degrading the earth’s natural capital at an inordinate rate. In addition to direct effects, environmental degradation also has a major impact on social issues such as health, economy, poverty and national security.

In 1987 the Brundtland Report, “Our Common Future”, introduced the concept of sustainable development to the general public. This framework, which provides a way to connect social, economic and environmental aspects, is widely accepted today. To integrate the principles of sustainable development into national policies and programmes and reverse the loss of environmental resources is consequently one of the targets of the UN millennium development goals. Its accomplishment and implementation present an enormous challenge. The difficulties are related to the high complexity of environmental systems. Steering towards sustainability requires thorough knowledge of natural environments and the interactions between humans and the environment. However, knowledge of the system alone is not enough. It must be complemented by precise ideas on how improvement of the state of the environment can be achieved, that is knowing “what should be” as well as “how this may be achieved”.

Engaging in an environmental sciences study programme means an intellectual challenge as well as accepting responsibility for a change of attitude in society towards sustainability.

1.2 Qualification Profile and Professional Opportunities

The teaching in the Master’s degree programme focuses on both subject-specific and general skills and competences, and builds upon the qualifications achieved in the Bachelor’s degree programme.

Subject-specific skills and competences: The Master’s degree programme involves specialisation in a major. The selection of subjects forms a coherent package combin-
2 The Master’s Programme in Environmental Sciences

The Department of Environmental Systems Science, D-USYS, provides an environment for conducting high-quality research covering a wide range of topics (www.usys.ethz.ch/en > Research). Teaching is undertaken by staff active in research and committed to the integrated theoretical and practically-based teaching programme. This ensures that graduates experience the challenge of tackling real research problems with state-of-the-art methods.

The Master’s degree programme offers opportunities to deepen specialised knowledge within a choice of fields. The aim of the programme is to provide training in those skills and abilities needed to address complex scientific issues at a high level of professional competence.

For contacts you may need during your Master’s degree programme go to section 9 of this guide and/or www.usys.ethz.ch/en > Studies > Environmental Sciences > Contacts

2.1 Structure of the Programme

The four-semester Master’s degree programme (120 credits) uses a credit system based on the European Credit Transfer System (ECTS). The primary language of instruction is English, although some lectures – the ones in this study guide listed with German titles – may be held in German. The language of instruction of each individual course is stated in the online course catalogue of ETH (www.vvz.ethz.ch). The Master’s degree programme in Environmental Sciences offers several specialisation subjects, majors and minors, allowing a programme to be chosen to match individual needs. The table below provides an overview of the elements of the Master’s degree programme. Master’s degree students must obtain credit points (CP) in the following categories:

<table>
<thead>
<tr>
<th>Categories</th>
<th>Kategorie</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td>Vertiefung</td>
<td>min. 40</td>
</tr>
<tr>
<td>Minor(s)/Elective Courses</td>
<td>Ergänzung(en)/Wahlfächer</td>
<td>min. 20</td>
</tr>
<tr>
<td>Internship</td>
<td>Berufspraxis</td>
<td>30</td>
</tr>
<tr>
<td>Master’s Thesis</td>
<td>Master-Arbeit</td>
<td>30</td>
</tr>
</tbody>
</table>

For two semesters, students focus on scientific topics related to their chosen major (cf. section 3). Minors and/or elective courses (cf. section 4) complement the core courses of their selected major. One semester is spent outside the ETH Zurich, gaining practical work experience during the professional internship (cf. section 5). Finally, a Master’s thesis is completed on a topic selected from the subject range of the major (cf. section 6).

Courses at other universities (e.g. University of Zurich, University of Bern, EPFL), which cannot be selected through myStudies, must be taken as “exchange courses”/”Mobilitätsfächer” (recognition in the Master’s degree programme only upon approval by the Directors of Studies!). Students must provide evidence of passing the required performance assessment issued by the university which offers the respective course (title of the course, CP, result/grade of the performance assessment).

Prerequisites for individual major courses are stated in the online ETH course catalogue.

2.2 Student Exchange

In the Master’s degree programme in Environmental Sciences, students may obtain credit points [CP] from another university: either a maximum of 20 CP is accredited as part of the elective courses (applicable only to Master students holding a Bachelor’s degree from ETH Zurich) or 30 CP are accredited for a Master’s thesis abroad (applicable to all students).

Students planning to take courses or work on a Master’s thesis during a study period abroad will find further information at www.usys.ethz.ch/en > Studies > Environmental Sciences > student exchange. Students also must obtain approval in advance from the departmental exchange coordinator of the Master’s degree programme in Environmental Sciences (cf. section 9).

Students intending to complete their Master’s thesis at another university are to identify an advisor at D-USYS (“supervisor”) and a tutor at their host university in advance. The regulations are given in the Programme Regulations under www.usys.ethz.ch/en > Studies > Environmental Sciences > Documents > Master > Programme Regulations.
3 Major Programmes

The choice of the major programme [Vertiefung] involves individual specialisation. However, the guidelines of each programme guarantee a selection of course units which form a coherent programme of study, encompassing an appropriate combination of knowledge, general methods, tools and techniques. In order to ensure that the individual study programme fits the individual needs, the students are encouraged to contact the responsible study advisor at the beginning of the Master’s degree programme.

Students are also advised to discuss prerequisites for their chosen major with the study advisor before starting their Master’s degree studies and to clarify which courses from the Bachelor’s degree programme should be chosen as elective courses to ensure prerequisites are met.

Students can choose one of the following six major programmes:
- Atmosphere and Climate
- Biogeochemistry and Pollutant Dynamics
- Ecology and Evolution
- Environmental Systems and Policy
- Forest and Landscape Management
- Human Health, Nutrition and Environment

The courses listed in the following sections refer to the ETH Zurich course catalogue valid on the press date of this brochure. The order of listing in each section follows these rules: all courses of study programme Environmental Science (numbers starting with 701) which take place in the autumn semester are listed first. Followed by courses of other study programmes in autumn semester with increasing numbers. The same rules apply for the spring semester. Courses and details (e.g. semester, CP) may be altered. Students should therefore verify the accuracy of the information by consulting the ETH Zurich online course catalogue www.vvz.ethz.ch at the beginning of the semester.

3.1 Major in Atmosphere and Climate

For advice regarding this major, students may contact Prof. Dr. Reto Knutti, reto.knutti@env.ethz.ch

Students in the Major in Atmosphere and Climate gain in-depth understanding of climate processes and their interactions – ranging from the molecular to the global scale and from short-lived phenomena to changes over millions of years. The programme offers quantitative knowledge on atmospheric dynamics, climate processes and feedbacks, biogeochemical cycles, paleoclimatology and in-depth training in numerical modelling of weather and climate.

Students start the major programme with an introduction course in the week prior to the beginning of the semester together with lecturers of the Institute of Atmospheric and Climate Science and with students of the University of Bern. In the first two terms of the programme students attend lectures, tutorials, and field courses that provide them insight in the field of atmospheric and climate science. The major in Atmosphere and Climate also offers an optional exchange programme with the University of Bern, which allows to gain experience in complimentary fields of atmospheric and climate science.

Students will
- gain an in-depth understanding of the atmospheric system, as well as of its interactions with the hydrosphere, cryosphere and biosphere
- comprehend the physical, chemical and biological background and apply theoretical descriptions
- be able to design, conduct and analyse field and laboratory experiments
- learn how to numerically model the observed systems

Specialised courses in the second term, together with the training of scientific tools, writing skills, presentation techniques and team work will help students prepare for their thesis work. During the period of their Master’s thesis students will be fully integrated into one of the research groups. The Master’s thesis is concluded by writing a thesis and presenting the results to colleagues in an oral presentation.

The curriculum of the major programme comprises the following categories with the minimum number of credit points [CP] to be acquired indicated.

The mandatory courses “Introduction course (2 CP)”, “Colloquia [3 CP]”, “Master-Seminars (6 CP)” and “Lab and Field Work (5 CP)” add up to 16 CP. Together with at least 24 CP gained in the three modules to be chosen, this results in a minimum of 40 CP for core courses in this major. Another 20 CP need to be obtained in the category “Elective courses”.

5

6
Mandatory courses (16 CP)

Introduction Course (2 CP)
701-1213-00 Introduction Course to Master Studies Atmosphere and Climate HS 2 G 2

Colloquia (3 CP)
651-4095-01 Colloquium Atmosphere and Climate 1 HS/FS 1 K 1
651-4095-02 Colloquium Atmosphere and Climate 2 HS/FS 1 K 1
651-4095-03 Colloquium Atmosphere and Climate 3 HS/FS 1 K 1

Seminars (6 CP)
701-1211-01 Master’s Seminar: Atmosphere and Climate 1 HS/FS 2 S 3
701-1211-02 Master’s Seminar: Atmosphere and Climate 2 HS/FS 2 S 3

Lab and Field Work (5 CP)
Several practical courses are offered from which students can choose. Some of these courses are block courses (typically field work) in the first weeks of the summer semester break, others will be carried out within the summer term parallel to other courses. One course will also train students in data analysis and numerical simulation. The learning goals are to conceive, carry out and analyse (statistically or causally modelling) an experiment independently or in a small team. Students will write reports as part of the grading for this course.

701-1260-00 Climatological and Hydrological Field Work FS 5 P 2.5
701-1262-00 Atmospheric Chemistry Lab Work FS 5 P 2.5
701-1264-00 Atmospheric Physics Lab Work FS 5 P 2.5
701-1266-00 Weather Discussion FS 2 P 2.5

Module Courses (24 CP)
Students need to select at least three out of the following five modules. The total number of credit points in the modules must amount to a minimum of 24 CP. However, to be valid, a minimum of 6 CP must be obtained in each module.

Weather Systems and Atmospheric Dynamics
The module Weather Systems and Atmospheric Dynamics encompasses the description and understanding of the fundamental processes that govern atmospheric motion on a wide range of scales (meso, synoptic, planetary). They form the basis of predicting and diagnosing the weather and the longer-term climate evolution.

701-1221-00 Dynamics of Large-Scale Atmospheric Flow HS 2 V + 1 U 4
651-4053-05 Boundary Layer Meteorology HS 3 G 4

Climate Processes and Feedback
The primary goal of this module is to understand the climate system with special focus on the atmosphere. Lectures will cover the basic physical processes of the atmosphere (thermodynamics, aerosol and cloud physics, radiation and dynamics). Application and analysis of certain aspects will be possible in the accompanying tutorials. Moreover, an overview of numerical methods that are used in weather and climate models with practical applications will be taught.

701-1235-00 Cloud Microphysics HS 2 V + 1 U 4
701-1251-00 Land-Climate Dynamics HS 2 G 3
701-1216-00 Numerical Modelling of Weather and Climate FS 3 G 4
701-1232-00 Radiation and Climate Change FS 2 G 3
701-1252-00 Climate Change Uncertainty and Risk: From Probabilistic Forecasts to Economics of Climate Adaptation

Atmospheric Composition and Cycles
Knowledge of atmospheric composition and chemistry is fundamental to understanding air quality, atmospheric oxidation capacity and climate. This module can be optimally combined with several of the other modules.

701-1233-00 Stratospheric Chemistry HS 2 V + 1 U 4
701-1239-00 Aerosols I: Physical and Chemical Principles HS 2 V + 1 U 4
701-1234-00 Tropospheric Chemistry FS 2 G 3
701-1238-00 Advanced Field and Lab Studies in Atmospheric Chemistry and Climate FS 2 P 3
701-1317-00 Global Biogeochemical Cycles and Climate FS 3 G 3

Climate History and Paleoclimatology
This module introduces methods and approaches in paleoclimatology. Students will have an understanding of the evolution of climate and its major forcing factors through geological time. They will be familiar with the use of the most common geochemical climate “proxies” and be able to evaluate the quality of marine and terrestrial sedimentary paleoclimatic archives.

651-4049-00 Conceptual and Quantitative Methods in Geochemistry
Weather and climate are intimately related to the hydrological cycle and land-surface processes. The interaction is two-way. On the one hand, precipitation and evaporation drive the terrestrial hydrological system with important implications for ecosystems and our economy (e.g. floods and droughts). On the other hand, land-surface processes affect the overlying atmosphere and thereby the climate system. This module provides an introduction to hydrological sciences, with particular attention to the weather/climate/land-surface link.

**Electives**

To acquire credit points in the category "Elective Courses" the following courses are recommended to supplement the corresponding modules:

- **UNIBE-.... = courses at the University of Bern**

**Weather Systems and Atmospheric Dynamics**

- 701-1236-00 Messmethoden in der Meteorologie und Klimaforschung HS 1 V 1
- 701-1258-00 The Global Atmospheric Circulation FS 1 G 1.5
- 701-1266-00 Weather Discussion FS 2 P 2.5

**Climate Processes and Feedbacks**

- 701-1221-00 Dynamics of Large-Scale Atmospheric Flow HS 2 V + 1 U 4
- 701-1257-00 European Climate Change HS 2 G 3
- 651-4057-00 Climate History and Palaeoclimatology HS 2 G 3
- UNIBE-6414 Climateology III (climate variability and change) HS 2 V 3
- UNIBE-7716 Specialist Course - Climate and Environmental Physics HS 2 V 2U 4
- 701-1226-00 Inter-Annual Phenomena and Their Prediction FS 2 G 2
- 701-1228-00 Cloud Dynamics: Hurricanes FS 3 G 4

**Atmospheric Composition and Cycles**

- 701-1235-00 Cloud Microphysics HS 2 V + 1 U 4
- 102-0635-01 Luftreinhaltung HS 4 G 6
- 651-4053-05 Boundary Layer Meteorology HS 3 G 4
- 701-0234-00 Messmethoden in der Atmosphärenchemie FS 1 V 1
- 402-0573-00 Aerosols II: Applications in Environment and Technology FS 2 V + 1 U 4
- 651-4004-00 The Global Carbon Cycle – Reduced HS 2 G 3

**Climate History and Palaeoclimatology**

- 651-4041-00L Sedimentology I: Physical Processes and Sedimentary Systems HS 2 G 3
- 651-4043-00L Sedimentology II: Biological and Chemical Processes in Lacustrine and Marine Systems HS 2 G 3
- 651-4901-00 Quaternary Dating Methods HS 2 G 3
- UNIBE-26396 Quaternary Climate Change and Terrestrial Ecosystems FS 2 V 3
- UNIBE-103709* Methods of Climate Reconstruction (every 2nd year) FS 2 V 3

* Takes place next time in spring semester 2020

**Hydrology and Water Cycle**

- 701-0535-00 Environmental Soil Physics/Vadose Zone Hydrology HS 2 G + 2 U 3
- 102-0287-00 Fluvial Systems HS 2 G 3
- 651-2915-00 Seminar in Hydrology HS 1 S 0
- 651-4023-00 Groundwater HS 3 G 4
- 701-1216-00 Numerical Modelling of Weather and Climate FS 3 G 4
- 701-1224-00 Mesoscale Atmospheric Systems—Observation and Modelling HS 2 V 2
- 102-0448-00 Groundwater II FS 4 G 6
- 102-0468-00 Watershed Modelling FS 2 G 3
- 102-0488-00 Water Resources Management FS 2 G 3
- 860-0012-00 Cooperation and Conflict Over Int. Water Resources FS 2 S + 2 A 3

**Recommended as additional elective courses**

- 701-1237-00 Solar Ultraviolet Radiation HS 1 V 1
- 651-4273-00 Numerical Modelling in Fortran HS 2 V 3
- 651-4273-01 Numerical Modelling in Fortran (Project) HS 1 U 1
3.2 Major in Biogeochemistry and Pollutant Dynamics

For advice regarding this Major, students may contact Prof. Dr. Martin Ackermann, martin.ackermann@env.ethz.ch

Biogeochemistry is an interdisciplinary science of physical, chemical and (micro-) biological processes controlling the regional and global cycles of elements and their compounds. Biogeochemists analyse the response of aquatic, terrestrial, and atmospheric systems to chemical changes induced by greenhouse gas emissions, nutrient loads, and accelerated cycles of metals and organic substances.

Identifying the present and future methane emission rates to the atmosphere from wetlands, man-made reservoirs and coastal sediments is just one example where ETH scientists from biogeochemistry work together with colleagues from atmospheric, earth and plant sciences.

In the coming years this branch of science will advance on different scales: Satellite remote sensing and coupled models will facilitate the identification of global trends. Microscale analysis with chemical sensors and X-ray spectroscopy open up the possibility of studying complex systems such as living biofilms and plant roots. The advances of molecular biology allow the precise identification of the active microorganisms involved in processes like methane production and oxidation.

Pollutant dynamics is the key word for studies of the distribution, transformation, and the effects of anthropogenic compounds. This integrative science follows an agenda to

- predict the pathways and the fate of organic and inorganic pollutants in environmental systems
- quantify their biogeochemical transformations
- assess their effects on terrestrial and aquatic life

Scientists in this field are confronted with a huge number of organic compounds that are in commercial use. Studying the physical-chemical partitioning of compound groups allows the prediction of their transfer between different environmental systems. Integrative field studies based on trace analysis, stable isotope techniques, and transport measurements help in identifying the relevant transformation pathways. The development of smart test systems such as cell cultures for assessing the effects of pollutants is another active field of research.

Students of the major in biogeochemistry should have an interest in interdisciplinary approaches and enthusiasm for a science that integrates complex field work, laboratory analysis and computer modelling.

The curriculum of the major programme comprises four modules. The minimum number of credit points (CP) to be acquired for each module is indicated below.
The expertise of ecologists and evolutionary biologists is increasingly needed to address many of the world’s most pressing scientific and social problems. Examples include how to reduce the spread of invasive species, to control pests and reduce the risk of emerging diseases, to prevent undesirable impacts of technologies such as agrochemicals and genetically modified organisms, and to ensure the sustainability of ecosystems used to produce food, energy and other natural products. Protecting the world’s biodiversity and maintaining ecosystem services in the face of changing land use, increasing human populations, rapid urbanisation and climate change are also crucial aspects of developing more sustainable human societies. To master these tasks students must become experts in ecology, population biology and evolution and have a good knowledge of the complexity and diversity of organisms. It also requires a sound knowledge of research methods, and an ability to take account of relevant political, social and economic factors.

The major programme in ecology and evolution aims to provide students with these skills and expertise, through a teaching programme that covers core issues of ecology, evolutionary biology, and conservation biology (modules “Foundations” and “Advanced Concepts”). The core of the Ecology and Evolution major is structured into Foundations, Advanced Concepts, Applications, Scientific Skills, and the Term Paper.

### Term Paper and Seminar (mandatory, 7 CP)

All students write a term paper on a challenging biogeochemical topic and present their results in a seminar. The seminar provides a forum for intellectual exchange among the student group.

- **701-1303-00** Term Paper 1: Writing HS/FS 6 A 5
- **701-1302-00** Term Paper 2: Seminar HS/FS 1 S 2

### Electives

To acquire credit points in the category “Elective Courses” the following courses are recommended:

- **701-1318-00** Metal Stable Isotopes in Environmental Geochemistry FS 2 G 1
- **102-0338-01** Biological Processes for Waste Treatment FS 2 G 3
- **651-4004-00** The Global Carbon Cycle – Reduced FS 2 G 3
- **651-4056-00** Limnogeology FS 2 G 3
- **751-4902-00** Moderne Pflanzenschutzmittel – Wirkungsweise, Rückstandsbildung und Umweltverhalten FS 2 V 2

### 3.3 Major in Ecology and Evolution

For advice regarding this Major, students may contact Dr. Dieter Ramseier, dieter.ramseier@env.ethz.ch

Ecology is the branch of biological sciences concerned with how living organisms interact with the environment. Ecologists study patterns of biodiversity, adaptations of species to their environment, the dynamics of plant, animal and microbial populations, the structure of natural communities and the functioning of ecosystems. All this knowledge is essential for understanding how human beings influence ecological systems, and for finding ways of managing them sustainably.

The study of evolution lies at the centre of modern biology. Not only has evolution produced the huge diversity of organisms that exist today, with their myriad of adaptations and life forms, but it is continuously at work as populations adjust to changing conditions. Evolutionary biologists investigate patterns of diversity as well as the processes causing genetic change in populations. Human activities are dramatically changing these processes and patterns in many organisms and habitats, including pests and diseases. An understanding of how evolution proceeds is therefore important, not only for our view of the world, but also to reduce unwanted impacts of man-made changes.

The expertise of ecologists and evolutionary biologists is increasingly needed to address many of the world’s most pressing scientific and social problems. Examples include how to reduce the spread of invasive species, to control pests and reduce the risk of emerging diseases, to prevent undesirable impacts of technologies such as agrochemicals and genetically modified organisms, and to ensure the sustainability of ecosystems used to produce food, energy and other natural products. Protecting the world’s biodiversity and maintaining ecosystem services in the face of changing land use, increasing human populations, rapid urbanisation and climate change are also crucial aspects of developing more sustainable human societies. To master these tasks students must become experts in ecology, population biology and evolution and have a good knowledge of the complexity and diversity of organisms. It also requires a sound knowledge of research methods, and an ability to take account of relevant political, social and economic factors.

The major programme in ecology and evolution aims to provide students with these skills and expertise, through a teaching programme that covers core issues of ecology, evolutionary biology, and conservation biology (modules “Foundations” and “Advanced Concepts”). The core of the Ecology and Evolution major is structured into Foundations, Advanced Concepts, Applications, Scientific Skills, and the Term Paper.

### Foundations (at least 8 CP)

Three foundations courses in Ecology, Evolution, and Infectious Disease challenge students with the core principles of the major, and ensure common levels of understanding as students advance. The courses present contemporary perspectives on the ecological and evolutionary dynamics of populations, communities, and infectious diseases. Students participate in at least two of these courses but are encouraged to take all three.

- **701-1427-00** Experimental Evolution HS 2 S 4
- **701-0328-00** Advanced Ecological Processes FS 2 V 4
- **701-1708-00** Infectious Disease Dynamics FS 2 V 4

### Advanced Concepts

[Advanced Concepts and Applications courses must sum to at least 12 CP]

Students select from a range of courses building in depth knowledge of specific areas of ecology and evolution.

- **701-0263-00** Seminar in Evolutionary Ecology of Infectious Diseases HS 2 G 3
- **701-1409-00** Research Seminar: Ecological Genetics HS 1 S 2
- **701-1471-00** Ecological Parasitology HS 1 V + 1 P 3
- **701-1676-01** Landscape Genetics HS 3 G 2
Applications

Advanced Concepts and Applications courses must sum to at least 12 CP

Students explore the management, conservation, and restoration of diverse biological systems, building an appreciation for the relevance of ecological and evolutionary principles to the informed management of natural areas.

Scientific Skills (at least 6 CP)

A major in ecology and evolution leads to a range of careers requiring technical expertise. Students have the opportunity to build strength in: Quantitative and Computational Expertise, Laboratory and Field Expertise, and Expertise in Biological Diversity.

Electives

Students gain breadth by enrolling in courses across all of environmental sciences. The following courses are recommended:

- 701-1441-00 Alpine Ecology and Environments
- 551-0205-00 Challenges in Plant Sciences
- 751-4504-00 Plant Pathology I
- 701-1414-00 Evolutionary Biology: Field Course
- 751-5110-00 Insects in Agroecosystems
- 751-5118-00 Global Change Biology

**Course will not be offered in autumn semester 2018**
3.4 Major in Environmental Systems and Policy

For advice regarding this major, students may contact Prof. Dr. Antony Patt, anthony.patt@usys.ethz.ch or Prof. Dr. Michael Stauffacher, michael.stauffacher@usys.ethz.ch

The major in Environmental Systems and Policy (ESP) trains students to analyse environmental problems in order to design effective policies to address current issues. The ESP major stands out among the other majors in Environmental Science as it not only provides the training and tools to help solve environmental problems but also an understanding of the human aspect of such problems and the associated solutions.

The core of the ESP major is a training in policy analysis applied to environmental problems. In this program, “policy” means a strategy to address a particular problem, typically designed and implemented by governments, but also by civil society and, in some cases, by the private sector. Analysing such policies involves a full consideration of their likely effects – whether they will adequately solve the problem at hand, and whether they will create another problem in the process – as well as their political and social acceptability. While this training is grounded in the relevant aspects of social science theory, the emphasis is on practical application in today’s world.

Policy analysts are increasingly in demand in public agencies, non-governmental organizations, and the private sector, such as in consulting firms. With their skill set, they often advance into leadership roles. Graduates of the Master degree programme with the ESP major will stand out because of their unique qualifications, combining an in-depth understanding of environmental systems science with the knowledge and skills required to identify solution strategies that are environmentally, technically, and socially robust.

Prerequisites
A BSc degree with the specialisation “Human-Environment Systems” is a good basis, but also all the other specialisations offered within the Bachelor’s degree programme in Environmental Sciences from the ETH Zurich or a BSc degree in similar fields from other universities are a good foundation.

The curriculum of the ESP major programme is structured in three modules, each with a minimum of 9 and a maximum of 22 CP. Within each module, there is one mandatory subject (required course). The total amount of CP has to sum up to 40.

Module 1: Theoretical foundations for environmental policy (at least 9 CP)
The first module covers the theoretical foundations based on relevant social sciences, including economics, political science, and psychology. Within this module, students will learn to appraise the relevant criteria by which to judge a policy’s success, as well as the factors that influence its political and social acceptability.

Required course (3 CP)
701-1651-00 Environmental Governance
or
701-1563-00 Climate Policy

And at least the remaining 3 or 6 CP (depending on whether Environmental Governance or Climate Policy was taken as the mandatory course) from the following courses:
701-0727-00 Politics of Environmental Problem Solving in Developing Countries
701-1563-00 Climate Policy
851-0585-41 Computational Social Science
851-0609-06 Governing the Energy Transition
860-0023-00 International Environmental Politics
701-0758-00* Ökologische Ökonomik: Grundlagen und Wachstumskritik
701-0764-00* Kritische Auseinandersetzung mit dem ökonomischen Wachstumsparadigma
701-1652-00 Environmental Behaviour and Collective Decision Making
364-0576-00 Advanced Sustainability Economics
752-2121-00 Consumer Behaviour II
752-2123-00 Risk Awareness, Risk Acceptance and Trust
851-735-11 Environmental Regulation: Law and Policy

*Does not take place in spring semester 2019

Module 2: Modelling and Statistical Analysis (at least 9 CP)
This module consists of modelling, in terms of both simulating how the behaviour of a system may respond to a future policy intervention and evaluating data that reveal the effects of past interventions. The module has three core elements: conceptual system mapping, computer simulation and modelling, and statistical analysis, including econometrics.

Required course (6 CP)
860-0002-00 Quantitative Policy Analysis and Modeling
Students have to choose one minor focusing on environmental or technological systems:
Appropriate minors (cf. section 4; also see option below) are: "Analytical Chemistry", "Biogeochemistry", "Physical Glaciology", "Catchment Management and Natural Hazards", "Soil-plant Relations and Land Use", "Agricultural Plant Production and Environment", "Sustainable Energy Use" and "Life Cycle Assessment".

Students also have the flexibility to propose a set of courses from an area of environmental systems science for which no minor currently exists (e.g. concerning climate systems) to satisfy this requirement. The proposal has to be discussed with and to be approved by Prof. Dr. Michael Stauffacher (michael.stauffacher@usys.ethz.ch). For a word document to prepare the proposal go to www.usys.ethz.ch/en > Studies > Environmental Sciences > Documents > Master > Major in Environmental Systems & Policy – compulsory minor in natural/technological system.

3.5 Major in Forest and Landscape Management

For advice regarding this major, students may contact Florian Knaus, florian.knaus@env.ethz.ch

In many parts of the world, dramatic changes in human population and their economic status are taking place. Some regions are seeing a rapidly increasing population, whereas remote areas in other regions are witnessing depopulation. The requirements of the human population therefore are changing rapidly with regard to ecosystem goods and services. The results are over-utilisation and irreversible damage such as loss of biodiversity and erosion or, by decreasing use, problems such as lack of protection from natural hazards or loss of agricultural land. Anthropogenic changes such as nitrogen deposition and the expected climate change overlay these processes and will additionally affect ecosystems.

A key challenge therefore is to ensure the sustainable use of terrestrial ecosystems and natural resources in the face of continuous changes in society, economy and the environment. Forested landscapes play an important role as they provide numerous products such as timber or bio-energy, they influence biogeochemical cycles, have multiple feedbacks on the climate system at regional to global scales, are important for preserving biodiversity, and supply humans with numerous further goods and services.

To cope with current and future challenges, we need academics who understand the dynamics of near-natural ecosystems in a landscape context and can develop sustainable methods for the management of natural resources. Graduates of the major

And at least 3 CP from the following courses
701-1453-00 Ecological Assessment and Evaluation HS 3 G 3
701-1541-00 Multivariate Methods HS 2 V + 1 U 3
101-0491-00 Agent Based Modeling in Transportation HS 2 G 6
363-0541-00 Systems Dynamics and Complexity HS 3 G 3
701-1522-00 Multi-Criteria Decision Analysis FS 2 G 3
701-1674-00 Spatial Analysis, Modelling and Optimisation FS 4 G 5
363-1076-00 Diffusion of Clean Technologies FS 2 G 3
752-2110-00 Multivariate Statistical Analysis FS 2 V 3
860-0022-00 Complexity and Global Systems Science FS 2 V 3

Module 3: Policy Engagement (at least 9 CP)
This module forces students to step out of the ivory tower of scientific theory and into the real world in which decisions are made. Such engagement concentrates on three elements: the historical and current political context for environmental policy, group problem solving, and communication with stakeholders.

Required course (6 CP)
701-1562-00 Cases in Environmental Policy and Decision Making FS 4 S 6

And at least 3 CP from the following courses
701-1543-00 Transdisciplinary Methods and Applications HS 2 G 3
701-1551-00 Sustainability Assessment HS 2 G 3
701-1563-00 Climate Policy HS 3 G 6
701-0016-00 Philosophical Issues in Understanding Global Change FS 1 S 2
701-1350-00 Case Studies in Environment and Health FS 2 V 4
701-1502-00 Transdisciplinary Case Study FS 15 P 7
701-1653-00 Policy and Economics of Ecosystem Services FS 2 G 3
751-1652-00 Food Security – from the Global to the Local Dimension FS 2 G 2
751-2700-00 Bodenmarkt und Bodenpolitik FS 2 G 2
851-0735-11 Environmental Regulation: Law and Policy FS 1 S 2
860-0012-00 Cooperation and Conflict Over International Water Resources FS 2 S + 2 A 3

Electives
Students must complete a total of 20 CP in the category “Elective Courses”. In the ESP major programme at least ten of those 20 CP have to focus on a particular environmental system.
in Forest and Landscape Management have a good grasp of the multi-dimensional objectives of land use and landscape development and take them into account in the framework of hands-on problem solving. They have a thorough understanding of the dynamics of forest and landscape systems, and the ability to deal with complex problems as well as to integrate system, target and action knowledge. They learn to develop goal-oriented management schemes for forests and near-natural landscapes. Ultimately, they take on responsible positions in consulting companies, other private or public organisations, politics, administration and research.

**Prerequisites**
A BSc degree in Environmental Sciences ETH Zurich with the specialisation “Wald und Landschaft” is a good basis for this major programme, but also “Umweltbiologie”, “Biogeochemie” or “Mensch-Umwelt Systeme”. A BSc degree in similar fields from another university will serve as a valid foundation as well. Depending on the individual choices made during the Bachelor’s curriculum, students may need to acquire key knowledge and skills during the major programme that are conveyed in the context of the Bachelor’s specialisation “Wald und Landschaft” at ETH Zurich.

The core part of the major is composed of four modules; in addition, there is a project-related mandatory course (5 CP). Including the project-related work, a total of at least 40 CP have to be acquired from the core part of the major. The minimum number of CP required for every module is 5.

**Natural Science Foundations (at least 5 CP)**
Students acquire an understanding of natural processes necessary for ensuring the sustainable use of extensively managed landscapes.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1613-01</td>
<td>Advanced Landscape Research</td>
<td>HS</td>
<td>3 G 5</td>
</tr>
<tr>
<td>701-1644-00</td>
<td>Mountain Forest Hydrology</td>
<td>HS</td>
<td>3 G 5</td>
</tr>
<tr>
<td>701-1646-00*</td>
<td>Carbon and Nutrient Cycling in a Changing Climate and Land-Use</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Uncertain if course can be offered in spring semester 2018

**Forest Pathology and Insect Ecology, 5 CP consisting of**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1615-00</td>
<td>Advanced Forest Pathology</td>
<td>HS</td>
<td>2 G 3</td>
</tr>
<tr>
<td>701-0318-00</td>
<td>Ökologie und Management von Waldinsekten</td>
<td>FS</td>
<td>2 V 2</td>
</tr>
</tbody>
</table>

**Ecosystem Management (at least 5 CP)**
Students acquire the skills to develop and assess resource utilisation schemes that are biophysically feasible, economically efficient, ecologically justifiable and institutionally acceptable.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1631-00</td>
<td>Foundations of Ecosystem Management</td>
<td>HS</td>
<td>3 G 5</td>
</tr>
<tr>
<td>701-1635-00</td>
<td>Multifunctional Forest Management</td>
<td>HS</td>
<td>2 G 5</td>
</tr>
<tr>
<td>701-1636-01</td>
<td>Ökologie und Management von Gebirgswäldern</td>
<td>FS</td>
<td>3 G 5</td>
</tr>
</tbody>
</table>

**Decision Making, Policy and Planning (at least 5 CP)**
Students acquire the skills to analyse and support collective decision-making processes, and to analyse and adapt governance processes and instruments for the implementation of natural resource-related programs and projects.

**Landscape planning, 5 CP either by taking**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>103-0338-00*</td>
<td>Projektwoche Landschaftsentwicklung</td>
<td>FS</td>
<td>9 P 5</td>
</tr>
</tbody>
</table>

* This course has a limited capacity, participation of FLM students is safeguarded. The timing of the field week is coordinated with other FLM field courses.

**Environmental and Resource Economics, 5 CP consisting of**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1653-00</td>
<td>Policy and Economics of Ecosystem Services</td>
<td>FS</td>
<td>2 G 3</td>
</tr>
<tr>
<td>701-1654-00</td>
<td>Forest Economics and Environmental Valuation</td>
<td>FS</td>
<td>2 V 2</td>
</tr>
</tbody>
</table>

**Policy and Law, 5 CP consisting of**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1651-00</td>
<td>Environmental Governance</td>
<td>HS</td>
<td>2 G 3</td>
</tr>
<tr>
<td>701-0743-01</td>
<td>Rechtlicher Umgang mit natürlichen Ressourcen</td>
<td>FS</td>
<td>2 V 2</td>
</tr>
<tr>
<td>851-0735-11</td>
<td>Environmental Regulation: Law and Policy</td>
<td>FS</td>
<td>1 S 3</td>
</tr>
</tbody>
</table>

**Methods and Tools (at least 5 CP)**
Students enhance their methodological know-how for sampling, processing and analysing spatio-temporal data of large-scale systems, and increase their modelling and analytical skills (e.g. Geographic Information Technology).

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>CP</th>
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</thead>
<tbody>
<tr>
<td>701-1673-00</td>
<td>Environmental Measurement Laboratory</td>
<td>HS</td>
<td>4 G 5</td>
</tr>
<tr>
<td>701-1679-00</td>
<td>Spatial Modelling: From Climate &amp; Land Use</td>
<td>HS</td>
<td>3 G 5</td>
</tr>
<tr>
<td></td>
<td>Change to Biodiversity Conservation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>701-1674-00</td>
<td>Spatial Analysis, Modelling and Optimisation</td>
<td>FS</td>
<td>4 G 5</td>
</tr>
</tbody>
</table>

**Project-related Work (mandatory, 5 CP)**
The project-related work consists of an interdisciplinary project in which students work in teams on real-world cases. The project aims at providing a set of complex problems that require the integration of different knowledge domains and that sharpen science-based problem solving skills.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1692-00</td>
<td>Interdisciplinary Project</td>
<td>FS</td>
<td>8 P 5</td>
</tr>
</tbody>
</table>
Electives
To acquire credit points in the category “Elective Courses”, the following courses are particularly suitable for the major Forest and Landscape Management:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>Lecture</th>
<th>Exercise</th>
<th>Credit Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1452-00</td>
<td>Wildlife Conservation and Management</td>
<td>FS</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>751-5118-00</td>
<td>Global Change Biology</td>
<td>FS</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

Ecosystem Management

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>Lecture</th>
<th>Exercise</th>
<th>Credit Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1453-00</td>
<td>Ecological Assessment and Evaluation</td>
<td>HS</td>
<td>3</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>701-1661-00*</td>
<td>Conservation and Development in Complex Landscapes</td>
<td>HS</td>
<td>6</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>701-1663-00*</td>
<td>Exploring Resilience of Tropical Forest Landscapes</td>
<td>HS</td>
<td>9</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>701-1448-00*</td>
<td>Strukturen und Dynamik europäischer Naturwälder (Feldkurs)</td>
<td>FS</td>
<td>4</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>701-1456-00*</td>
<td>Applied Ecosystem Management (Field Course in Serbia)</td>
<td>FS</td>
<td>4</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>701-1542-00</td>
<td>Erschliessungs- und Erntesysteme der Landnutzung</td>
<td>FS</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>701-1640-00</td>
<td>AK des multifunktionalen Waldmanagements</td>
<td>FS</td>
<td>6</td>
<td>U</td>
<td>3</td>
</tr>
</tbody>
</table>

* takes places every other year:

- autumn semester 19 701-1661-00 and autumn semester 20 701-1663-00;
- or spring semester 20 701-1456-00 and spring semester 19 701-1448-00

Prerequisites

A BSc degree in Environmental Sciences ETH Zurich with the specialisation “Environmental Biology”, “Biogeochemistry” or “Human-Environment Systems” provides a solid basis for this major programme. However, students need to acquire sound knowledge and skills during the second and third Bachelor’s year in the field of human nutrition as well as human anatomy and physiology. Depending on the chosen modules training in environmental organic chemistry and immunology is essential.

The curriculum of the major programme comprises the four modules listed below and a term paper. The module “Public Health” is mandatory for all students of this major. Two further modules have to be chosen.

While within the module “Public Health” and each of the two other modules a minimum of 10 credit points must be acquired, the total minimum number of credit points to be earned in three modules is 34 (34 CP + 6 CP from the Term Paper add up to a minimum of 40 CP for the major).

Public Health  [mandatory for all students of this major programme]  
This module includes all aspects of public health including the patterns of community health, epidemiology and statistical concepts, as well as biological and environmental determinants, the role of the social sciences, communication and monitoring of food safety in public health.

3.6 Major in Human Health, Nutrition and Environment

For advice regarding this major, students may contact Dr. Roland Regös, roland.regoes@env.ethz.ch

Human health is determined by complex interactions between individual lifestyles (food, nutrition, behaviour), environmental factors (e.g. climate, pollutants, infectious diseases, radiation) and societal aspects (e.g. medical infrastructure, information, prevention, regulation). The major in Human Health, Nutrition and Environment focuses on pollutants, infectious diseases and diet as examples of important factors affecting human health. Moreover it also addresses the understanding of the influence of these factors on human health under changing conditions (e.g. urbanisation, migration, climate change, pollution). The programme promotes the understanding of the complex underlying mechanisms by taking an integrative, systemic approach, bridging the molecular, cellular, organismal and population levels. This approach fosters integrative thinking and provides the basis to map out strategies on a societal level to improve human health. This interdisciplinary programme therefore combines the biomedical knowledge with a system-oriented view on the human population.
### Infectious Diseases

Infectious diseases are still among the major causes of death world-wide. To understand and eventually control the spread of these diseases we need to consider the demography, agricultural and ecological factors in addition to microbiology and immunology. In this module, we account for this complexity and introduce students to a discipline that has been recently called "One Health".

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Semester</th>
<th>Credits</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-0263-01</td>
<td>Seminar in Evolutionary Ecology of Infectious Diseases</td>
<td>HS</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>701-1471-00</td>
<td>Ecological Parasitology</td>
<td>HS</td>
<td>1 V + 1 P</td>
<td>3</td>
</tr>
<tr>
<td>701-1703-00</td>
<td>Evolutionary Medicine for Infectious Diseases</td>
<td>HS</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>551-0223-00</td>
<td>Immunology III</td>
<td>HS</td>
<td>2 V</td>
<td>4</td>
</tr>
<tr>
<td>752-4009-00</td>
<td>Molecular Biology of Foodborne Pathogens</td>
<td>HS</td>
<td>2 V</td>
<td>3</td>
</tr>
<tr>
<td>701-1708-00</td>
<td>Infectious Disease Dynamics</td>
<td>FS</td>
<td>2 V</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Term Paper (mandatory)

The term paper is mandatory for all students and is designed to provide experience in literature-based research and write review-type of paper in collaboration with representatives of this major.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Semester</th>
<th>Credits</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1701-00</td>
<td>Human Health, Nutrition and Environment:</td>
<td>HS</td>
<td>13 A</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Term Paper</td>
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</table>

### Nutrition and Health

This module is primarily designed to describe and discuss the impact of diet and lifestyle on obesity and chronic diseases in the industrialised world, but it also includes the negative health consequences of insufficient food and micronutrient deficiencies in the developing world. The module promotes food-based strategies to maintain health and to prevent disease and offers a broad spectrum of disciplines from nutrigenomics through nutrition to consumer behaviour with a special emphasis on the physiology of eating.

<table>
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<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Semester</th>
<th>Credits</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>752-2122-00</td>
<td>Food and Consumer Behaviour</td>
<td>HS</td>
<td>2 V</td>
<td>2</td>
</tr>
<tr>
<td>752-5103-00</td>
<td>Functional Microorganisms in Foods</td>
<td>HS</td>
<td>2 G</td>
<td>3</td>
</tr>
<tr>
<td>752-6101-00</td>
<td>Dietary Etiologies of Chronic Disease</td>
<td>HS</td>
<td>2 V</td>
<td>3</td>
</tr>
<tr>
<td>752-6402-00</td>
<td>Nutrigenomics</td>
<td>HS</td>
<td>2 V</td>
<td>3</td>
</tr>
<tr>
<td>752-1300-01</td>
<td>Food Toxicology</td>
<td>FS</td>
<td>1 V</td>
<td>2</td>
</tr>
<tr>
<td>752-6102-00</td>
<td>The Role of Food and Nutrition for Disease Prevention</td>
<td>FS</td>
<td>2 V</td>
<td>3</td>
</tr>
<tr>
<td>752-6302-00</td>
<td>Physiology of Eating</td>
<td>FS</td>
<td>2 V</td>
<td>3</td>
</tr>
</tbody>
</table>

### Environment and Health

This module focuses on chemical and microbial pollutants, particularly in water. It considers their impact on the environment and looks at the role of human behaviour in this context. It deals with the exposure, annoyances and risks for humans from these factors. The module provides an understanding of the biochemical and cellular mechanisms as well as processes in natural and technical systems.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Semester</th>
<th>Credits</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1341-00</td>
<td>Water Resources and Drinking Water</td>
<td>HS</td>
<td>2 G</td>
<td>3</td>
</tr>
<tr>
<td>701-0662-00</td>
<td>Environmental Impacts, Threshold Levels and Health Effects</td>
<td>FS</td>
<td>2 V</td>
<td>3</td>
</tr>
<tr>
<td>701-1312-00</td>
<td>Advanced Ecotoxicology</td>
<td>FS</td>
<td>2 V</td>
<td>3</td>
</tr>
<tr>
<td>701-1350-00</td>
<td>Case Studies in Environment and Health</td>
<td>FS</td>
<td>2 V</td>
<td>4</td>
</tr>
<tr>
<td>701-1704-01</td>
<td>Health Impact Assessment: Concepts and Case Studies</td>
<td>FS</td>
<td>2 V</td>
<td>3</td>
</tr>
</tbody>
</table>
4 Minor Programmes and Elective Courses

Minors (Ergänzungsfächer) are units of several lectures, which focus on a specific subject and are awarded with at least 10 CP. Selecting two minors gains the required 20 credit points. As “Elective Courses”, basically courses from the complete ETH course catalogue can be taken. Students not taking any minors or choosing elective courses in addition to a minor have various possibilities of gaining 20 or 10 credit points respectively (cf. section 4.13).

4.1 Minor in Sustainable Energy Use

For advice regarding this minor, students may contact Dr. Christoph Baumberger, christoph.baumberger@usys.ethz.ch.

The minor “Sustainable Energy Use” introduces students to the production, distribution and consumption of energy. The goal of this minor is to prepare students to interact with experts from the energy sector. With a deepened understanding of the energy sector and its dynamics students will be able to present the environmental science point of view in a more differentiated manner. The minor is designed for students who plan to work in the energy sector. Since energy relates to all majors of environmental sciences, it can be recommended to all interested major students. The learning targets are, depending on the selected courses, to become acquainted with renewable energy production, storage and energy conservation, with the electricity market and the strategic positioning of renewable energies, or with the successful planning of renewable energy projects.

701-0967-00* Projektentwicklung im Bereich erneuerbarer Energien
701-1346-00 Carbon Mitigation
051-0551-00 Energie- und Klimasysteme I
151-0209-00** Renewable Energy Technologies I
227-0731-00 Power Market I - Portfolio and Risk Management
701-0962-02 Energietechnik und Umwelt
151-0928-00 CO2 Capture and Storage and the Industry of Carbon-Based Resources

227-0730-00 Power Market II - Modeling and Strategic Positioning
363-0514-00 Energy Economics and Policy
529-0191-01 Renewable Energy Technologies II, Energy Storage and Conversion

* Very good German skills required
** Does not take place in autumn semester 2018

4.2 Minor in Global Change and Sustainability

For advice regarding this minor, students may contact Dr. Christoph Baumberger, christoph.baumberger@usys.ethz.ch.

Global Change and Sustainability encompass a wide range of environmental issues, such as climate change, soil degradation, biodiversity, desertification, fresh water resources and urbanisation. These challenges are intimately linked to policy issues. The minor provides a policy-oriented inter- and transdisciplinary introduction to current themes in this area.

The programme is specifically designed for students with a background in natural sciences. The courses enable students to integrate the economic, social and political dimensions of the associated debates in sustainability assessment and policy design and to reflect on the understanding of global change and sustainability gained by scientific methods.

Course list from which students have to achieve at least 10 credits

701-0015-00 Transdisciplinary Research: Challenges of Interdisciplinarity and Stakeholder Engagement
701-0019-00 Readings in Environmental Thinking
701-1551-00 Sustainability Assessment
551-0209-00 Sustainable Plant Systems
860-0023-00 International Environmental Politics
701-0016-00 Philosophical Issues in Understanding Global Change
701-1653-00 Policy and Economics of Ecosystem Services
751-5118-00 Global Change Biology
860-0012-00 Cooperation and Conflict Over International Water Resources
4.3 Minor in Transdisciplinarity for Sustainable Development

For advice regarding this minor, students may contact Prof. Dr. Michael Stauffacher, michael.stauffacher@usys.ethz.ch.

The minor in "Transdisciplinarity for Sustainable development" addresses the issue of sustainable development from a methodological perspective, namely to understand and improve how science can collaborate with society: It introduces different methods and tools how to structure wicked problems; it addresses concepts and methodologies how to assess sustainable development with a special focus on justice related issues; it integrates knowledge from various disciplines and actors to develop strategic actions. The minor combines theoretical, conceptual and methodological introductory courses with concrete application in real-world case studies. It targets students who want to learn how to concretely tackle problems of sustainable development both from a scientific and practically oriented perspective.

701-1543-00 Transdisciplinary Methods and Applications HS 2 G 3
701-1551-00 Sustainability Assessment HS 2 G 3
701-1502-00 Transdisciplinary Case Study FS 15 P 7

4.4 Minor in Life Cycle Assessment

For advice regarding this minor, students may contact Prof. Dr. Michael Stauffacher, michael.stauffacher@usys.ethz.ch.

Life-cycle assessment is a widely applied tool to assess environmental impacts along a product’s life-cycle. With this minor, the students learn about environmental assessment methodologies and their various applications. The goal is to qualify students for further academic studies at the PhD level as well as for practical work in engineering or consulting industry. The minor requires basic knowledge of environmental assessment tools. Theoretical input is combined with computer lab, exercises and practical case studies.

101-0577-00 An Introduction to Sustainable Development in the Built Environment HS 2 G 3
102-0317-00 Advanced Environmental Assessments HS 2 G 3
102-0317-03 Advanced Environmental Assessment (Computer Lab I) HS 1 U 1
102-0317-04 Advanced Environmental Assessment (Computer Lab II) HS 2 P 2

4.5 Minor in Analytical Chemistry

For advice regarding this minor, students may contact Dr. Martin Badertscher, martin.badertscher@org.chem.ethz.ch.

Chemical analysis is a cornerstone of quantitative natural and environmental science. It is central for air and water quality monitoring, food safety, in pharmaceutical and agro-industry, and in the clinical environment. The minor “Analytical Chemistry” is designed to provide students with a good working knowledge of modern analytical methods and their application. The minor targets students who want to prepare themselves for either a Ph.D. in the environmental or chemical sciences, or for a career in industry, in an engineering/consulting company that may design monitoring studies, or in a regulatory/government office at the cantonal, national, or international level.

A particular goal of the minor is to teach students the tools to independently design analytical strategies and carry out studies to solve practical problems that involve chemical analysis, such as themes centered around persistent organic pollutants (POPs) or endocrine disruptors in the environment. Students will gain an understanding of the applications and limitations of modern analytical technologies and will be able to carry out proper quantitative chemical analysis.

Prerequisites
(usually completed during the Bachelor’s degree programme ETH Environ. Sc.)
529-0051-00 Analytische Chemie I HS 3 G 3
529-0289-00 Instrumentalanalyse organischer Verbindungen FS 2 V 2

Minor Courses
529-0041-00 Moderne Massenspektroskopie, gekoppelte Analysenmethoden, Chemometrie HS 3 G 6
529-0043-01 Analytical Strategy HS 3 G 6
4.6 Minor in Biogeochemistry

For advice regarding this minor, students may contact Prof. Dr. Martin Ackermann, martin.ackermann@env.ethz.ch.

Biogeochemists analyse the distribution and transformation of natural and anthropogenic compounds in the earth system. Students of this minor obtain a deeper process-level understanding, allowing them to assess and predict the fate of elements and chemical compounds in the environment. Students should be interested in linking molecular perspectives with interdisciplinary approaches. To gain 10 CP students have to choose at least one course from each module.

Understanding Processes

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Type</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1313-00</td>
<td>Isotopic and Organic Tracers in Biogeochemistry</td>
<td>HS</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>701-1315-00</td>
<td>Biogeochemistry of Trace Elements</td>
<td>HS</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>701-1310-00</td>
<td>Environmental Microbiology</td>
<td>FS</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>701-1317-00</td>
<td>Global Biogeochemical Cycles and Climate</td>
<td>FS</td>
<td>3</td>
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</table>

Applying Biogeochemical Knowledge for Problem-solving

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>701-1341-00</td>
<td>Water Resources and Drinking Water</td>
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<tr>
<td>701-1346-00</td>
<td>Carbon Mitigation</td>
<td>HS</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>102-0337-00</td>
<td>Landfilling, Contaminated Sites and Radioactive Waste Repositories</td>
<td>HS</td>
<td>2</td>
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</tr>
</tbody>
</table>

4.7 Minor in Physical Glaciology

For advice regarding this minor, students may contact Dr. Hanna Joos, hanna.joos@env.ethz.ch.

The learning goals of this minor are comprehensive knowledge on components of the cryosphere with focus on the physical background and engineering applications. Depending on the choice of courses, different foci are offered: Achieving knowledge on the physics of glaciers and numerical modelling of the thermomechanics of glaciers, basic knowledge on glaciers and snow/avalanches for engineering applications, and knowledge of the role of the cryosphere in the climate system.

Course list from which students have to achieve at least 10 credits

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Type</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-0565-00</td>
<td>Grundzüge des Naturgefahrenmanagements</td>
<td>HS</td>
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<td>3</td>
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<tr>
<td>101-1250-00</td>
<td>Wildbach- und Hangverbau</td>
<td>HS</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>102-0293-00</td>
<td>Hydrology</td>
<td>HS</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>651-3525-00</td>
<td>Ingenieurgeologie</td>
<td>HS</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>651-4088-03</td>
<td>Physische Geographie III (Universität Zürich):</td>
<td>HS</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Geomorphic und Glaciologie</td>
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<tr>
<td>701-1808-00</td>
<td>Ingenieurbiologie</td>
<td>FS</td>
<td>2</td>
<td>2</td>
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<tr>
<td>101-0288-00</td>
<td>Snow and Avalanches: Processes and Risk Management</td>
<td>FS</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

4.8 Minor in Catchment Management and Natural Hazards

(Predominantly in German)

For advice regarding this minor, students may contact Prof. Hans R Heinimann, hans.heinimann@env.ethz.ch.

The water channel network is a dominant structure of catchment areas that affects physical, biological and human activities. The scientific-technical revolution of the 19th-century resulted in a split-up of the investigation and management of those areas, represented by several scientific disciplines. The challenge is to reintegrate the scattered analysis and design activities into a more holistic landscape and resource management approach. A more holistic approach aims at analysing and understanding the interactions between geomorphologic, atmospheric, hydrologic, biological and anthropogenic processes, and designing land-use regimes that control hydrologic and geomorphologic processes in a way that minimises the degradation of resources and maximises the resilience of the whole system.

Course list from which students have to achieve at least 10 credits

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Type</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-0565-00</td>
<td>Grundzüge des Naturgefahrenmanagements</td>
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<td>3</td>
</tr>
<tr>
<td>101-1250-00</td>
<td>Wildbach- und Hangverbau</td>
<td>HS</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>102-0293-00</td>
<td>Hydrology</td>
<td>HS</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>651-3525-00</td>
<td>Ingenieurgeologie</td>
<td>HS</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>651-4088-03</td>
<td>Physische Geographie III (Universität Zürich):</td>
<td>HS</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Geomorphic und Glaciologie</td>
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<td></td>
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</tr>
<tr>
<td>701-1808-00</td>
<td>Ingenieurbiologie</td>
<td>FS</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>101-0288-00</td>
<td>Snow and Avalanches: Processes and Risk Management</td>
<td>FS</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

* Bei dieser LE werden nur die KP der Vorlesung angerechnet.
4.9 Minor in Operations Engineering and Management for Forest and Timber Industries

For advice regarding this minor, students may contact Prof. Hans R Heinimann, hans.heinimann@env.ethz.ch.

Forest operations engineering and management research aims at (1) understanding the fundamental principles that underlie the behavior of forest operations systems and at (2) developing concepts, methods and tools that support the design, control and management of these systems.

The basic research paradigm represents operations systems as flow networks and uses mathematical models to describe its behavior and to evaluate the efficiency, effectiveness and environmental performance of alternate policies, strategies, and practices. The operations core is a system that includes research, design, engineering, production within operating units, networks of information and material flows that tie operating units together, and the development, distribution and delivery of goods and services to customers. A minor in Forest Operations Engineering and Management covers three different aspects of designing, controlling and continuously improving supply chains in the forest sector:

1. Production technology
2. Production management
3. Environmental management

It enables students to understand and apply methods of production and operations sciences.

Production Technology

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>Year</th>
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<tbody>
<tr>
<td>101-0637-10</td>
<td>Holzstruktur und Funktion</td>
<td>HS</td>
<td>2 G 3</td>
</tr>
<tr>
<td>101-0637-20</td>
<td>Holzbearbeitung und -verarbeitung</td>
<td>HS</td>
<td>2 G 3</td>
</tr>
<tr>
<td>701-1542-00</td>
<td>Erschliessungs- und Erntesysteme der Landnutzung</td>
<td>FS</td>
<td>2 G 4</td>
</tr>
<tr>
<td>101-0678-00</td>
<td>Holphysik &amp; Holzbasierte Materialien</td>
<td>FS</td>
<td>2 G 3</td>
</tr>
<tr>
<td>363-0448-00</td>
<td>Global Operations Strategy</td>
<td>FS</td>
<td>3 G 3</td>
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Production Management

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>Year</th>
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<tbody>
<tr>
<td>363-0445-00</td>
<td>Production and Operations Management</td>
<td>HS</td>
<td>2 G 3</td>
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<td>363-0445-02</td>
<td>Production and Operations Management</td>
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Environmental Management

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>102-0317-00</td>
<td>Advanced Environmental Assessments (Computer Lab I)</td>
<td>HS</td>
<td>2 G 3</td>
</tr>
<tr>
<td>102-0317-03</td>
<td>Advanced Environmental Assessment (Computer Lab II)</td>
<td>HS</td>
<td>1 U 1</td>
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<tr>
<td>102-0317-04</td>
<td>Advanced Environmental Assessment (Computer Lab II)</td>
<td>HS</td>
<td>2 P 2</td>
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</tbody>
</table>

4.10 Minor in Soil-Plant Relations and Land Use

For advice regarding this minor, students may contact Prof. Dr. Ruben Kretzschmar, ruben.kretzschmar@env.ethz.ch.

With this minor, students gain advanced knowledge in various aspects of soil-plant relations and nutrient cycling in natural and managed ecosystems. Courses range from process oriented understanding of plant-soil relations to aspects of land use planning and land use policy. Students choosing this minor should be interested in soils as a natural resource, nutrient cycling in soil-plant systems, and current problems of land use.

At least 6 credit points have to be gained from the list of Block I: Soil-Plant Relations.

Block I: Soil-Plant Relations

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-1681-00</td>
<td>Element Balancing and Soil Functions in Managed Ecosystems</td>
<td>HS</td>
<td>2 G 3</td>
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<tr>
<td>751-3405-00</td>
<td>Chemical Nature of Nutrients and their Availability to Plants: The Case of Phosphorus</td>
<td>HS</td>
<td>2 G 4</td>
</tr>
<tr>
<td>751-5101-00</td>
<td>Biogeochemistry and Sustainable Management</td>
<td>HS</td>
<td>2 G 2</td>
</tr>
<tr>
<td>751-3404-00</td>
<td>Nutrient Fluxes in Soil-Plant Systems: The Case of Nitrogen</td>
<td>FS</td>
<td>4 G 4</td>
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Block II: Land Use

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>103-0317-00</td>
<td>Nachhaltige Raumentwicklung I</td>
<td>HS</td>
<td>2G 3</td>
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<tr>
<td>103-0435-01</td>
<td>Landmanagement</td>
<td>HS</td>
<td>4G 5</td>
</tr>
<tr>
<td>751-5201-00</td>
<td>Tropical Cropping Systems, Soils and Livelihoods (with Excursion)</td>
<td>HS</td>
<td>2G 5</td>
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<tr>
<td>103-0458-00</td>
<td>Haushaltersche Bodennutzung</td>
<td>FS</td>
<td>2G 3</td>
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<tr>
<td>751-2700-00</td>
<td>Bodenmarkt und Bodenpolitik</td>
<td>FS</td>
<td>2G 2</td>
</tr>
</tbody>
</table>

* Takes place every other year, next time autumn semester 2018
4.11 Minor in Agricultural Plant Production and Environment

For advice regarding this minor, students may contact Prof. Dr. Achim Walter, achim.walter@usys.ethz.ch.

Agricultural plants form the basis for all our food systems and they are currently grown on more than half of the global land area on which plants can thrive. Therefore, their production often takes on a central role in questions of land use, biodiversity, soil degeneration, climate change, biogeochemical cycles, and other environmental issues. The minor in Agricultural Plant Production and Environment conveys in depth knowledge of important crops, grassland systems, plant production methods, cropping systems, and of interactions between agricultural plants and the environment. Students selecting this minor should have a profound interest in plant biology.

At least 6 credit points have to be gained from the list of „Advanced Courses“.

Basic Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Type</th>
<th>Credits</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>751-3700-00</td>
<td>Ökophysiologie</td>
<td>HS</td>
<td>2</td>
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<tr>
<td>751-0280-00L</td>
<td>Kulturpflanzen im World Food System</td>
<td>FS</td>
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<tr>
<td>751-4002-00</td>
<td>Graslandsysteme</td>
<td>FS</td>
<td>2 G</td>
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<tr>
<td>751-4107-01</td>
<td>Einführung in den Acker- und Futterbau</td>
<td>FS</td>
<td>2 V</td>
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Advanced Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>Credits</th>
<th>ECTS</th>
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<tbody>
<tr>
<td>751-4003-01</td>
<td>Current Topics in Grassland Sciences (HS)</td>
<td>HS</td>
<td>2 S</td>
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<tr>
<td>751-4104-00</td>
<td>Alternative Crops</td>
<td>HS</td>
<td>2 V</td>
<td>2</td>
</tr>
<tr>
<td>751-4704-00</td>
<td>Weed Science II</td>
<td>HS</td>
<td>2 G</td>
<td>3</td>
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<tr>
<td>751-5001-00</td>
<td>Agroecologists without Borders</td>
<td>HS</td>
<td>2 S</td>
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<tr>
<td>751-5003-00*</td>
<td>Sustainable Agroecosystems II</td>
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<tr>
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<td>Current Topics in Grassland Sciences</td>
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<td>2 S</td>
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<tr>
<td>751-4902-00*</td>
<td>Moderne Pflanzenschutzmittel – Wirkungsweise,</td>
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<td></td>
<td>Rückstandsbildung und Umweltverhalten</td>
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</tbody>
</table>

* In German only

4.12 Minor in Environmental, Resource and Food Economics

For advice regarding this minor, students may contact Dr. Robert Huber, rhuber@ethz.ch.

The minor in Environmental, Resource and Food Economics provides students with the necessary knowledge and skills to address economic and socio-economic issues related to natural resource management. The minor consists of lectures and seminars on topics such as environmental, resource, agricultural and food economics. As some of the courses deal with advanced topics, basic knowledge in microeconomics is required (as covered in 751-0901-00 “Einführung in die Mikroökonomie”, or equivalent courses).

At least 6 credit points have to be gained from the list of Block I.

Block I (Basic Courses)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Type</th>
<th>Credits</th>
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<tbody>
<tr>
<td>751-0903-00</td>
<td>Mikroökonomie des Agrar- und Lebensmittel-sektors</td>
<td>HS</td>
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<td>2</td>
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<tr>
<td>751-1311-00</td>
<td>Einführung in das Agrarmanagement</td>
<td>HS</td>
<td>2 V</td>
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<tr>
<td>751-1500-00</td>
<td>Entwicklungsoekonome</td>
<td>FS</td>
<td>2 V</td>
<td>3</td>
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<tr>
<td>751-1555-00</td>
<td>Applied Food Industrial Organisation</td>
<td>FS</td>
<td>2 G</td>
<td>3</td>
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<tr>
<td>751-1560-00</td>
<td>Produktion, Investition und Risikomanagement in der Landwirtschaft</td>
<td>FS</td>
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Block II (Applied Courses)

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<th>Type</th>
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<th>ECTS</th>
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<tbody>
<tr>
<td>751-1651-00</td>
<td>Evaluation of Agricultural Policies</td>
<td>HS</td>
<td>2 G</td>
<td>3</td>
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<tr>
<td>751-2103-00</td>
<td>Socioeconomics of Agriculture</td>
<td>HS</td>
<td>2 V</td>
<td>2</td>
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<tr>
<td>860-0023-00</td>
<td>International Environmental Politics</td>
<td>HS</td>
<td>2 V</td>
<td>3</td>
</tr>
<tr>
<td>751-1552-00</td>
<td>Agrarische Ressourcen-und Umweltökonomie</td>
<td>FS</td>
<td>2 V</td>
<td>2</td>
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<tr>
<td>751-2102-00</td>
<td>History of Food and Agriculture</td>
<td>FS</td>
<td>2 V</td>
<td>3</td>
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<tr>
<td>751-2312-00</td>
<td>Agrarpolitik</td>
<td>FS</td>
<td>2 G</td>
<td>2</td>
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</tbody>
</table>
4.13 Elective Courses

Courses from the entire ETH course catalogue (online) and a number of courses at the University of Zurich can be taken as elective courses. Students not taking any minors or choosing elective courses in addition to a minor have thus various possibilities of gaining credit points.

Each major and minor course can be individually chosen as an elective course. By taking elective courses recommended in the list of the chosen major programme the knowledge gained in the major may be deepened and expanded; by choosing complementary or interdisciplinary courses it may be broadened.

Students with special interests in statistics may enrol in the recommended courses in this field.

Students who have to fulfil additional requirements before starting their Master’s thesis are not allowed to count these additional courses towards the category “Elective Courses”.

Cf. section 8.2: It is also possible to gain the 20 credit points required in the category elective courses in view of the prerequisites for the Teaching Diploma (“Lehrdiplom”) in Biology, Chemistry and Physics or the Teaching Certificate (“Didaktik Zertifikat in Umweltlehre”; language of instruction is German). Some of the lectures for the Teaching Diploma or Certificate can be count for both the Master’s Degree Programme and Teaching Diploma or Certificate. For details see www.usys.ethz.ch > Studies > Teacher Training.

Especially Recommended Elective Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Semester</th>
<th>Type</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>701-0019-00</td>
<td>Readings in Environmental Thinking</td>
<td>HS</td>
<td>S</td>
<td>3</td>
</tr>
<tr>
<td>701-1504-00</td>
<td>ETH Sustainability Winter School</td>
<td>HS</td>
<td>G</td>
<td>1</td>
</tr>
<tr>
<td>363-1065-00</td>
<td>Design Thinking: Human-Centred Solutions</td>
<td>HS</td>
<td>G</td>
<td>5</td>
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<td>to Real World Challenges</td>
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<td>Transdisciplinary Case Study</td>
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<td>101-0437-10</td>
<td>Urban Mobility</td>
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<td>101-0588-02</td>
<td>Grounded Materials</td>
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English for Academic Purposes

Those Master students who want to improve their English take one or two courses in “English for Academic Purposes”, offered by the Language Center of the University and ETH Zurich is recommended:

Academic Reading, Speaking, and Vocabulary (B2)  HS/FS  2  G  2
Academic Reading, Speaking, and Vocabulary (B2-C1) und (C1)  HS/FS  2  G  2
Understanding Lectures & Participating in Discussions (B2)  HS/FS  1  U  1
Developing Presentation Skills - Science and Engineering (B2.2-C1)  HS/FS  1  U  1
Writing your Master’s Thesis - Science and Engineering (C1-C2)  HS/FS  2  G  2

It is important that students register at the Language Center (“Sprachenzentrum”, www.sprachenzentrum.uzh.ch) and bring a signed confirmation (to the administration office for Master students) after they have passed a course if they wish to receive credits (enrolment via myStudies not possible). These courses can then be accredited as elective courses and are listed on the current transcript (Leistungssüberblick) and the Academic Record.

For recognition and acceptance of language courses in the category “Elective Courses” (max. 4 CP) offered by the “Sprachenzentrum” (enrolment at the Language Center and via myStudies – if possible – essential!), the following restrictions apply: Courses in English, French, Italian, and Spanish are only accredited from level B2 (advanced) onwards. German language courses are only accredited from level C2 onwards.
5 Professional Internship (Berufspraxis)

The professional internship is a compulsory part of the Master's degree programme and should last for at least 18 weeks (full-time workload). During the internship, students will learn how to professionally handle environmental issues outside of ETH through their own practical experiences. They should apply the knowledge acquired from their studies. The internship can be completed in Switzerland or abroad, which broadens experience of how environmental problems are addressed in other countries.

Finding an internship position
Students must find the internship themselves. The following resources are available to aid in the search for an internship:
- register with addresses of Swiss companies offering internships (www.intranet.usys.ethz.ch/UMNW/berufspraxis/Praxisregister; Login with a nethz password)
- a platform with current open internship positions (www.intranet.usys.ethz.ch/UMNW/Stellen)
- Overview of on-going and previous internships including reports (www.intranet.usys.ethz.ch/UMNW/berufspraxis/Berufspraxisarbeiten; Login with a nethz password)

Further the internship advisor may be consulted to discuss any ideas (during office hours or on appointment; cf. section 9).

During the internship, students must register in the Master of Environmental Sciences and apply for a leave of absence, reason for absence: Compulsory Practical Experience. Afterwards, students must enrol in the course “701-1001-00 P Berufspraxis(Internship)”

Agreement on the content of the internship
In advance, the student and the company where the internship will take place prepare and sign an internship agreement on the nature of the internship, especially on the intern’s tasks. The internship advisor and the sup-porting lecturer at D-USYS (a person from the teaching staff at D-USYS/ETH) then have to approve the agreement with their signatures too. Students should submit their internship agreement to the internship advisor as early as possible, but no later than the second week of the internship. The agreement is pivotal for the recognition of the internship as fulfilment of the compulsory internship requirement.

By the end, students must document their internship in a personal report and enclose a professional dossier from their tasks.

For more detailed information about the different aspects of the compulsory internship please go to www.usys.ethz.ch/en > Studies > Environmental Sciences > Master > Internship

701-1001-00 Berufspraxis (Internship) HS/FS P 30

6 Master’s Thesis

The Master’s thesis is a scientific thesis written independently by the student and shall closely reference to the scientific field of the chosen specialisation subject.

Permission to write the Master’s thesis is only granted to students who
- have successfully completed their Bachelor’s studies,
- have fulfilled all prerequisites for admission to the programme,
- have completed at least 32 of the required 40 CP in the core subjects of their specialisation.

The Master’s thesis is to be completed out under the supervision of a professor or a private lecturer of the department or one of the departments’ authorised senior researchers.

The duration of the Master’s thesis is set to maximum 28 weeks (6 months plus 2 weeks). The supervisor sets the starting and submission dates. On request the Director of Studies can extend the deadline if cogent grounds are given.

For projects offered, authorised advisors and further information go to www.usys.ethz.ch/en > Studies > Environmental Sciences > Master > Master’s thesis

701-1002-00 Master’s Thesis HS/FS D 30

Declaration of Originality
A signed “Declaration of Originality” must be attached to the submitted thesis!

The writing platform SkriPS – "Scientific Writing Practice" provides students with information and support for writing their thesis (> http://moodle.let.ethz.ch > Nethz Login).
7 Assessments and Master’s Degree

7.1 General

All regulations concerning studies at the ETH are available in the “Rechtssammlung der ETH Zürich” under www.ethz.ch > Studies > Degrees, credit & grading systems, legal basis > Legal basis. The credit system used is based on the European Credit Transfer System (ECTS). Credits are a standard measure for the students’ working time required to reach the educational goals. Calculations are based on a total of 1500 to 1800 working hours per year, equivalent to 60 credits. Thus, 1 credit corresponds to 25 to 30 hours of total work.

Assements are in the form of written or oral examinations, written reports, oral presentations and active participation (e.g. in field courses, colloquia, seminars). Assessments can be held during the semester, as end-of-semester examinations or as examinations at the end of semester holidays. Details are given in the course catalogue. Both the examinations and the Master’s thesis are evaluated with a grade between one (lowest) and six (highest). Other assessments may also be rated with passed/failed.

Credits are only issued, and always allocated in their full amount, for satisfactory performance according to the requirements stated in the ETH course catalogue. Study performances are considered satisfactory if they receive a grade of at least 4.0 or “passed”. An assessment “failed” can be repeated once. After each examination session in spring and autumn students have to make sure that their interim academic record in myStudies is complete.

For further information see the Programme Regulations for the Master of Science ETH in Environmental Sciences (Studienreglement 2013 für den Master-Studiengang Umwelt naturwissenschaften, Ausgabe 22.05.2015-2).

7.2 Assessments of the Master’s Programme

The instruction language at the Master’s level is English, however written and oral assessments may be offered in English or German. Students must inform the responsible examiner in writing at the time they register for an examination that they will complete the performance in the language of their choice.

Major Courses
Courses pertaining to the major programme are evaluated by means of a performance assessment. The type and timing of the performance assessments are outlined in the ETH course catalogue.

Minor Courses and Elective Courses
Courses of minors as well as elective courses are also evaluated by means of a performance assessment, which are outlined in the ETH course catalogue.

Professional Internship
The performance will be assessed on the basis of the report(s) by the supervising lecturer and the internship advisor with passed/failed and if approved, 30 credit points will be awarded.

Master’s Thesis
At least two authorised persons mark the Master’s thesis using the department’s official assessment criteria (downloadable under www.usys.ethz.ch/en > Studies > Environmental Sciences > Documents > Master). One of the assessors must be the main advisor, the other may either be an additional advisor or another specialist in the field of the Master’s thesis.

7.3 Master’s Degree

Request for Degree Conferral
The Master’s degree is awarded when a total of 120 credits, in accordance with the regulations for the major chosen and the programme regulations (cf. section 2.2), is reached. Students should then apply to the students’ administration office (Studien sekretariat) for the conferral of the Master’s degree.

Final Academic Record, Degree and Academic Title
Graduates receive a final academic record in German and a transcript thereof in English. While interim academic records contain any evaluated study performance, in the final academic record only courses and performance assessments indicated in the application are listed. Upon request by the student, further performance evaluations can be listed in an addendum to the final academic record. The grade point average on the final academic record is calculated as the weighted mean of the grades listed in the application. The weighting corresponds to the credit points allocated to each course. The grade for the Master’s thesis is weighted as 30. With the final academic record (in German and English), graduated students will receive a Master’s certificate [in German, French or Italian] and a diploma supplement. The diploma supplement gives a short description of all courses attended during the Master’s degree programme, also showing the awarded credits.
8 Educational Possibilities beyond Bachelor and Master

8.1 Doctorate

The Department of Environmental Systems Science and its research institutions offer outstanding conditions for a doctorate: an innovative atmosphere, state-of-the-art equipment and laboratories, and an environment inspiring young scientific talents to be successful. The doctorate involves independent scientific research work supervised by a professor.

Doctoral studies at the ETH Zurich generally take three to four years. On successful completion, candidates are awarded the title "Doctor of Sciences (Dr. sc. ETH Zürich)". Details and regulations for doctoral studies at the Department of Environmental Systems Science can be found under www.usys.ethz.ch/en/doctorate.

8.2 Teaching Certificate/Teaching Diploma for Grammar Schools

The Department of Environmental Systems Science offers a Teaching Certificate (Didaktik-Zertifikat) in Environmental Studies, which provides graduates with a basic didactic qualification for a broad range of professional activities in the field of education. A Teaching Diploma in Biology, Chemistry or Physics depending on the chosen major can be completed at ETH departments of biology, chemistry or physics. However candidates might be requested to fulfill extensive additional requirements. These Teaching Diplomas provide accreditation to teach at a grammar school (Gymnasium). In all these programmes, the language of instruction is German.

Die nachfolgend beschriebenen didaktischen Ausbildungsgänge können nach dem Erwerb des Bachelor-Diploms begonnen werden:

**Didaktik-Zertifikat in Umweltlehre**


**Lehrdiplom für Maturitätsschulen (Teaching Diploma)**

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**9 Information and Advice**

**Admission and Application**
Online information for prospective students is available under www.ethz.ch/en/studies/master

The two-year Master’s degree programme is open to students with a Bachelor’s degree with an emphasis on environmental sciences, or an equivalent degree. Students who meet the admittance criteria stated in the programme regulations for the Master in Environmental Sciences can apply to the ETH Rectorate to enter the Master’s degree programme in Environmental Sciences.

**General Information** on studies at the ETH Zurich: www.ethz.ch/en/studies

**Specific Advice**

**Study Course Advisor and Coordinator Academic Affairs**
Advice and scheduling regarding individual curricula and admission, Teaching Certificate or Teaching Diploma
Dr. Susanne Lambrecht, CHN H 42.1 Universitätsstrasse 8, 8092 Zurich, phone: +41 (0)44 633 60 82, email: susanne.lambrecht@usys.ethz.ch

**Administration Office for Master Students – e.g. Master’s thesis, Master’s degree**
Advice and Administration regarding Militär- und Zivildienstverschiebung / Déplacement de service militaire ou civile / Differimento del servizio militare o civile
Haller Diana, CHN H 41, Universitätsstrasse 8, 8092 Zurich, phone: +41 (0)44 632 53 75, email: diana.haller@usys.ethz.ch

**Director of Studies for the Degree Programmes in Environmental Sciences**
Requests and applications for exceptions concerning the curriculum and programme regulations; requests for prolongations of Master’s theses; requests for grade corrections
Prof. Dr. Bernhard Wehrli, Institut für Biogeochemie und Schadstoffdynamik, CHN E 19.1, 8092 Zürich, Tel.: 044 632 85 05, email: bernhard.wehrli@env.ethz.ch

**Advisor for Professional Internships in the Environmental Sciences Master’s Programme**
Andrea Funk, CHN H 42.2, Universitätsstrasse 8, 8092 Zurich, phone: +41 (0)44 632 25 64, email: berufspraxis@usys.ethz.ch
Advisor and Administration for Student Exchange
Dr. Susanne Lambrecht, CHN H 42.1 Universitätssstrasse 8, 8092 Zurich,
phone: +41 (0)44 633 60 82, email: studentexchange.umnw@usys.ethz.ch

Advice and Administration regarding a Doctorate at D-USYS
Madlaina Gartmann, CHN H 47, Universitätssstrasse 8, 8092 Zurich,
phone: +41 (0)44 632 25 23, email: phd@usys.ethz.ch

Study Advisor “Humanities” for Master students, who have to fulfil additional requirements in Social Sciences and Humanities and/or do a “Bachelor’s thesis” as an admission requirement
Dr. Christoph Baumberger, CHN H 73.1, Institut für Umweltentscheidungen,
Universitätstrasse 16, 8092 Zurich,
phone: +41 (0)44 632 50 54, email: christoph.baumberger@usys.ethz.ch

Addresses, phone numbers, email addresses, etc... of the teaching staff can be found in the online ETH Zurich course catalogue.
Information

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Department of Environmental Systems Science (D-USYS)
Advice for Master Students
CHN H 42.1
Universitaetsstrasse 8
8092 Zurich
Switzerland

env_master@usys.ethz.ch
www.usys.ethz.ch
Phone +41 44 633 60 82 (Mo, Tu, Th, Fr)

Office hours
Monday, Tuesday, Thursday and Friday 1 – 3 pm

Consultation on appointment (by e-mail)